PHILIPPINE ZOOLOGICAL EXPEDITION
1946-1947

NARRATIVE AND ITINERARY

HARRY HOOGSTRAAL

FIELDIANA: ZOOLOGY
VOLUME 33, NUMBER 1
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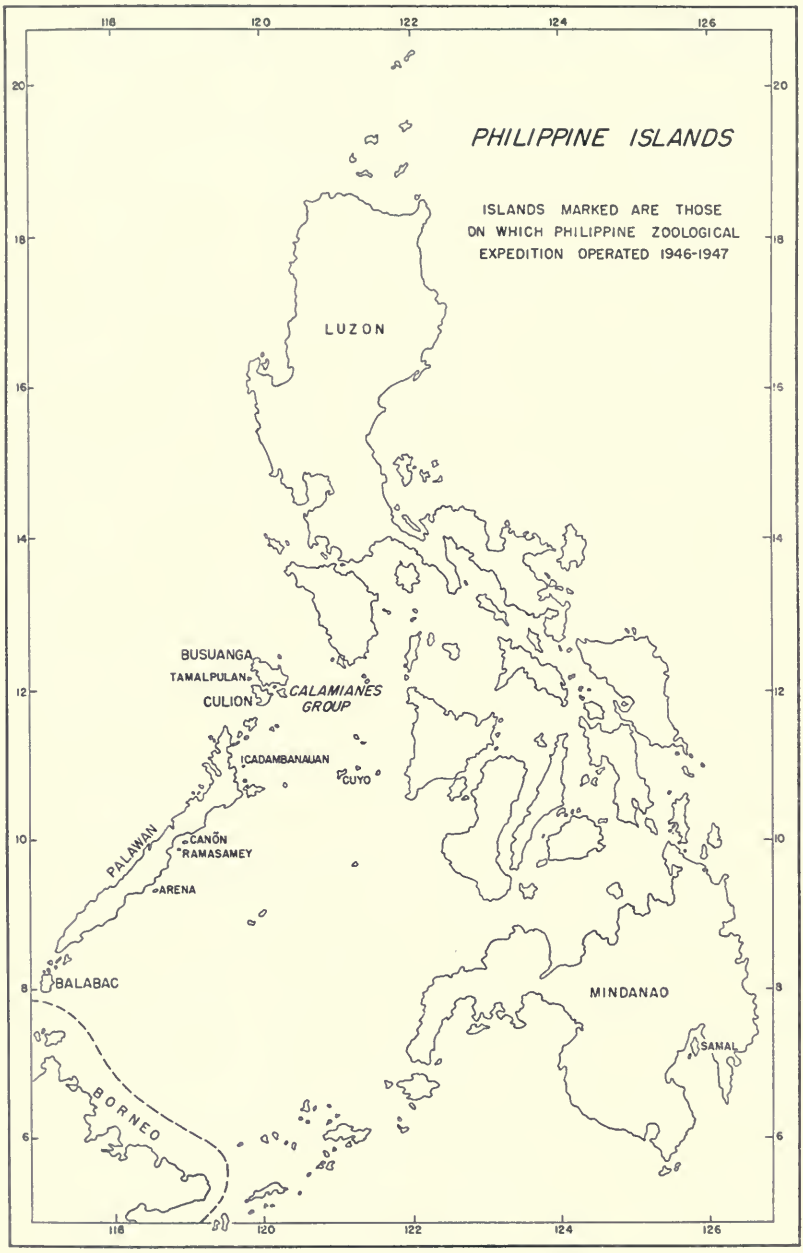

FIG. 1. The Philippine Islands. The islands named on the map are those on which the Philippine Zoological Expedition of 1946–47 made collections.

The Philippine Expedition

INTRODUCTION

The Philippine Zoological Expedition began its field operations less than a year after the termination of hostilities of World War II in the Pacific area. The plans had gradually evolved in the course of war-time correspondence with Mr. Karl P. Schmidt, Chief Curator of the Department of Zoology, in Chicago Natural History Museum. Each of us considered that we should avail ourselves of the opportunity to use some of the surplus stores of United States Army equipment already in the Pacific and the services of experienced and enthusiastic naturalist-soldiers who were willing to take their discharge overseas for the purpose of collecting zoological specimens of species poorly represented in American museums.

Lieutenant Donald Heyneman, Infantry, Army of the United States, a pre-war student at Harvard University and an enthusiastic naturalist and observer, quickly volunteered to join the expedition. Mr. Floyd Werner, a student of entomology, who had recently been discharged from the Army, was employed by Chicago Natural History Museum, and arrived a few weeks after our Mindanao operations began. He had also been a pre-war Harvard student and had been employed by the Museum of Comparative Zoology.

The Philippine Islands (fig. 1) were selected as our locale, and an opportunity for mutual benefit to Chicago Natural History Museum and the Philippine National Museum presented itself. The Bureau of Science building in Manila (see pl. 1) and the once important Philippine Museum collections had been destroyed in the war, and the Museum personnel was eager to get into the field again. Arrangements were accordingly concluded between Chicago Museum and the Honorable José Camus, Undersecretary of Agriculture and Commerce of the newly established Philippine Republic, whereby the Philippine Government furnished the services of several expedition members, whose salaries it paid, and Chicago Museum, besides furnishing its own personnel, agreed to pay all expenses and to identify and store all specimens, which were to be divided between the two institutions, until such time as the Philippine Museum should again have facilities to care for its collections.

Dr. Eduardo Quisumbing, Director of the Philippine National Museum, and Dr. Canuto G. Manuel, Curator of the Zoological Collections, made their museum staff members available for the field work. Their personnel varied from time to time as individuals were transferred to other governmental duties or were detained in Manila. Those who were members of the expedition at one time or another are as follows: Messrs. Dioscoro S. Rabor, Manuel Celestino, Arturo Castro, Gregorio Edaño, Godofredo Alcasid, Herminio R. Rabanal, Pascual Convocar, Prudencio Añonuevo, and Telesforo Oañe. Añonuevo and Oañe were employed first by Chicago Natural History Museum and later by the Philippine National Museum.

While we were preparing for the expedition, officials of the United States Army requested us to continue the exploration of little-known areas of the Philippines for rare and new species of mosquitoes that attack man, a project that I had initiated in my military capacity in the Nineteenth Medical General Laboratory. The Army provided supplies and travel facilities in return for specimens and such data as we could obtain on the prevalence of insect-borne disease in the areas visited.

We were aware that travel would have to be limited because of high costs, so we chose the three most important Philippine type localities of mammals as our base points and decided to concentrate our collecting in these areas. The localities selected were (1) Mount Data in Mountain Province, Luzon; (2) Mount Apo and the surrounding lowlands of Davao Province in Mindanao; and (3) Puerto Princesa in Palawan. Our side trips were to be made as opportunities offered themselves and funds allowed. By specializing on mammals, and collecting as many as possible of other vertebrate and invertebrate species, we were able to obtain a satisfactory representation of the fauna of several parts of the archipelago. As a result of the cordial relations established between the two museums participating in the expedition, it is hoped that collections from intervening areas can gradually be obtained through co-operative efforts.

The Philippine Republic at this time was hardly beginning to recover from the great losses suffered during World War II. Inter-island steamship sailings were uncertain and greatly reduced in number, and the boats were crowded. Most of the few roads in Mindanao had deteriorated, and few bridges remained. Plane service to populated places was excellent, however, and accidents were rare.

While we were able to obtain a considerable amount of our provisions and supplies from surplus United States Army stores, we were continually harassed during the first six months we were in the field by our inability to get deliveries of specialized equipment ordered from the United States. For several months we collected birds and mammals with only rat traps and two old shotguns, our ammunition consisting of skeet loads from Army stores.

The Moro areas of Mindanao were closed to travel at this time and lawless elements in other areas, as well as unsettled political conditions, necessitated some caution. However, with a reasonable amount of care, we were able to operate with few untoward incidents, and the great friendliness of a large portion of the population of the Philippines was so genuine that we were willing to overlook many difficulties.

In all, the expedition remained in the field for about twelve months. April and May of 1946 were spent in Mountain Province and in Abra Province, Luzon. Much of July and early August was spent at dock or at sea en route from Manila to Davao, Mindanao. The entire party spent three weeks of August, all of September, and part of October on Mount McKinley, where Werner joined us on August 20. From there we moved to the lowlands of Tagum Municipality at the north end of Davao Gulf for a few weeks. Later in October, and continuing into November, we established camps on Mount Apo, and smaller field parties worked the Davao and Cotabato lowlands until February, 1947. Lieutenant Heyneman returned to the United States late in December, 1946, because of illness. The period from February to mid-May, 1947, was spent in the islands of Palawan Province. During the last days of May and the first few days of June, 1947, Werner collected insects at Las Baños and Mount Makiling, in Luzon.

A considerable botanical collection was made, at least parts of which will be reported on elsewhere. Mr. Gregorio Edaño, a veteran collector of the Philippine Museum, was largely responsible for these collections. In the mountains of Davao few of the party could resist the temptation to bring representatives of the magnificent flora, especially mosses, ferns, and orchids, back to camp, and Edaño's work was often confined to the pressing and drying of the specimens. These collections were left with Dr. Eduardo Quisumbing, Director of the Philippine Museum, who is distributing them to specialists for study. Similar sets are to be deposited in the herbaria of the Philippine Museum and Chicago Natural History Museum.

Acknowledgement of help and co-operation given the expedition by many persons is a great pleasure, because of the fine friendships formed and also because the assistance of many individuals contributed so much to the success of the expedition. In Manila, Dr. Marcos Tubangui, of the Bureau of Science, and his family, offered us the hospitality of their home, considerable storage space for supplies, and much good advice. Colonel Dwight M. Kuhns, Medical Corps, United States Army, Commanding Officer of the Nineteenth Medical General Laboratory (now known as the Third Medical General Laboratory) extended many courtesies, as did his successor, Colonel H. Livesay. Numerous other members of the Laboratory staff, among them Lieutenant S. A. Edgar, Captain Calvin Calmon, Major Thomas Moore and Captain Carl Bruck, gave valuable assistance. In the offices of the newly formed Philippine Republic, the Honorable José M. Camus, Undersecretary of Agriculture and Commerce, made the official arrangements for our work. Our friends, Dr. Eduardo Quisumbing, Director of the Philippine National Museum, and Dr. C. G. Manuel, Curator of the Zoological Collections, took an active interest in organizing the expedition.

In the field, our many hosts were so largely responsible for our good fortunes that much of the credit is due them. At Davao City, headquarters for our Mindanao operations, Major Clinton Feeney, the Enemy Property Custodian, supplied us not only with pleasant living quarters and good food between trips, but also with valuable laboratory and storage space. The members of his staff, Lieutenant William Patton, Captain Thomas Bilbo, Sergeant Walter Thompson, and Corporal Albert Shipske, were as friendly and co-operative as Major Feeney. At Puerto Princesa, headquarters of our operations in Palawan Province, Major Howard T. Wright, Air Corps, Commanding Officer of the Palawan Army Air Base, was also cordial and helpful. He has enriched our collections with numerous specimens obtained by himself and by many members of his command.

At Caburan, Davao Province, Mr. William Joyce, his brothers, John and Henry, and their families showed us great hospitality, gave us much information, and materially assisted in collecting tarsiers and the monkey-eating eagle. At Madaum, Davao Province, Mr. Richard Bownass and his family extended their hospitality and gave us the use of valuable facilities at the International Harvester Company plantations. Mr. Bownass also encouraged his employees to bring in valuable specimens. At near-by Maco, Mr. Pedro de la

Piña showed equal hospitality to our group. In Davao City, Mr. Merle Robie, manager of the Columbian Rope Company, was invaluable because of his great store of information on Mindanao, and because of his assistance with arrangements for shipping specimens. The entire staff of the Philippine Army Military Police Command at Davao City stood ready to assist us at all times. Mr. Guino of Davao City generously did a major repair job on the expedition truck without cost to us. Finally, in Mindanao, the kindly chief of the Bogobo village of Todaya on Mount Apo, who is known as Impit Bogobo, earned our gratitude by his hospitality and active assistance.

While we were in Palawan, we received much assistance from the Provincial Governor, the Honorable Alfredo Abueg. When the Philippine Surplus Property Commission took over the Palawan Army Air Base during our stay, Major Cesar P. Roces and Captain Delfin C. Cella continued the interest and co-operation of Major Wright. At Iwahig, Major E. B. Misa, Director of Prisons, and Mr. Paje, the local Superintendent, allowed us to operate in the Penal Colony area, an important type locality and collecting area, and Mr. Barney French, who has great knowledge of Palawan animals, contributed valuable information and specimens. At Brooke's Point, we received the hospitality of Mr. William H. Edwards, without whose sage advice the trip into the Mantalingajan Mountain Range would hardly have been possible. The assistance of Mr. Roy Blank on Balabac Island made our short stay there profitable. On Busuanga Island, we were indebted to Mr. William de Carbonel, the Joaquin family, and the Sandoval family for hospitality and assistance.

We are also indebted to the President and the Director of Chicago Natural History Museum, Mr. Stanley Field and Colonel Clifford C. Gregg, and to the Chief Curator of Zoology, Mr. Karl P. Schmidt, for having made the expedition possible, as well as for advice and encouragement. To the late Boardman Conover, member of the Board of Trustees and Research Associate in Ornithology, we are indebted for active interest and for contributions to the financing of the expedition. Mr. Frank C. Wonder, of the Museum's taxidermy staff, was indefatigable in obtaining and packing our special equipment, a difficult task in those post-war days.

These notes of indebtedness would hardly be complete without further mention of the members of the field parties by whose efforts the collections were obtained. Lieutenant Heyneman spent many

hours helping with the preliminary plans and arrangements and was tireless in obtaining and packing supplies. In the field, before his departure for the United States because of serious illness, he was in charge of innumerable trying details, and his care and enthusiasm never failed. Mr. Werner, an excellent insect collector, not only enhanced the collections with innumerable difficult-to-find invertebrates, but often took charge of field trips and collected vertebrates as well. Mr. Rabor, now Assistant Professor at Silliman University in Dumaguete, was invaluable because of his knowledge and experience and his great love for field work. Mr. Celestino, trained by his father, who made many of the classic Philippine collections, was a field man of ability and experience and it was a pleasure to have him with us. Mr. Castro, a newcomer in the field, was assiduous in the preparation of specimens. The botanical collector, Mr. Edaño, besides making his own collections, often tended camp and endeared himself by his pleasant company and tales of his thirty years of collecting experience. Two trainees, Messrs. Añonuevo and Oañe, learned much about the work of an expedition, and did much preparatory work. Mr. Alcasid, a member for part of the period, though trained as a conchologist, collected a number of vertebrate specimens and became proficient at field preparation techniques. Mr. Convocar, botanical assistant, learned mammal and bird preparation techniques while on the expedition. On the Luzon trip, Mr. Rabanal did general collecting.

The photographs that illustrate the present paper were made by Lieutenant Heyneman or myself. The maps in figures 1–6 are the work of Miss Margaret Bradbury, Staff Artist, Department of Zoology. Figure 7 was made by Miss Norma Lockwood, formerly Staff Artist.

LIST OF COLLECTING LOCALITIES

Localities appearing on expedition labels are listed below, and the municipality, province, and island (and, where necessary, island group) of each are indicated. Each locality is noted on a map or sketch in this paper with the following exceptions:

(1) Localities listed as "near" another locality are close to that locality and for reasons mentioned below are not spotted on the maps.

(2) Villages on very small islands are indicated here and on the labels but not on the maps.

(3) Numerous names of places in and contiguous with the boundaries of Iwahig Penal Colony are not shown on the maps but they appear on the labels and in this list. The penal colony is in Puerto Princesa Municipality but is not within the municipal jurisdiction.

Certain towns that are municipal seats are listed, though they were not necessarily collecting localities, because other localities within these municipal areas were worked.

Municipalities always bear the name of the municipal seat.

We have been unable to learn the names of the municipalities in which our Luzon localities are located.

A Philippine province is equivalent to a state in the United States and a "municipality" to a county. Reference of Philippine localities to their proper province and municipality is important because of the frequent repetition of certain common names.

Davao City (the city proper) is within an incorporated area that is referred to as Davao City Province. Numerous other villages, *barrios* (hamlets) and *sitios* (named localities) are outside the city yet within the province. A number of islands and island groups may be incorporated into a single political province, or there may be several provinces within a single island.

The large number of names of places quite near one another may be cumbersome, but we judged it necessary to use them because of striking dissimilarities between the specimens collected at near-by points. Unfortunately, we were unable to learn the exact position

of a number of localities for which place names were used by some of the Filipino members who were sent out on independent side trips. As a result some localities are listed on labels as "near" others.

Local variations exist in the spelling and pronunciation of many place names, especially among the different dialects, and in this list I have used the names appearing on the United States Coast and Geodetic Survey Maps, as far as available. For names in Palawan Province, United States Army maps are our authority. I have made every effort to obtain the correct names for those localities not appearing on maps. The difficulties that may arise in obtaining a single name are numerous. Several times we received from municipal authorities a name that was not in common use among the local populace. In remote places the authorities sometimes speak a dialect different from that of the local people and may modify the name to suit their own dialect. Differences between the name used in official documents and that used by the local residents are not infrequent; for example, most of the population of Davao City will tell one that near-by Mount McKinley is Mount Apo.

Elevations are listed here for specific localities in mountainous areas, but not for mountain peaks.

Aborabod, Culion Island, Coron Municipality, Calamianes group, Palawan Province.

Aborlan Municipality, Palawan Province, Palawan Island.

Abra Province, Luzon Island.

Agusan, Bukidnon Province, Mindanao Island.

Akbul, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.

Arena Island, Aborlan Municipality, Palawan Province.

Baay, Abra Province, Luzon Island.

Babuyan, Puerto Princesa Municipality, Palawan Province, Palawan Island.

Baclayan Camp (6,500 ft. elev.), east slope of Mount Apo, Davao Province, Mindanao Island.

Baclayan River (sulfur fumarole) Camp (7,700 ft. elev.), east slope of Mount Apo, Davao Province, Mindanao Island.

Bacungan, Puerto Princesa Municipality, Palawan Province, Palawan Island.

Badiang (est. 2,000 ft. elev.), near Tagabuli, Santa Cruz Municipality, Davao Province, Mindanao Island.

Baguio, Mountain Province, Luzon Island.

Baguio, Iwahig Penal Colony, Palawan Province, Palawan Island.

Balabac, Balabac Island, Balabac group, Palawan Province.

Balabac Island, Balabac group, Palawan Province.

Balcayo, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.

Banaag, Iwahig Penal Colony, Palawan Province, Palawan Island.

Bankarohan, Davao City Province, Mindanao Island.
Baracatan, near Todaya, Mount Apo, Davao Province, Mindanao Island.
Bataguen, Cuyo Island, Cuyo group, Palawan Province.
Beto, Buayan Municipality, Cotabato Province, Mindanao Island.
Bintuan, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.
Binuan, Iwahig Penal Colony, Palawan Province, Palawan Island.
Bonobono, Brooke's Point Municipality, Palawan Province, Palawan Island.
Borongotan; see Burungutan.
Brooke's Point (village), Brooke's Point Municipality, Palawan Province, Palawan Island.
Brooke's Point Municipality, Palawan Province, Palawan Island.
Buayan Municipality, Cotabato Province, Mindanao Island.
Bugad, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.
Bugasan, Bugasan Municipality, Cotabato Province, Mindanao Island.
Bukidnon Province, Mindanao Island.
Bula, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.
Buluan, Buluan Municipality, Cotabato Province, Mindanao Island.
Burungkôt, Upi Municipality, Cotabato Province, Mindanao Island.
Burungutan (also known as Borongotan), Upi Municipality, Cotabato Province, Mindanao Island.
Busaon, near Madaum, Tagum Municipality, Davao Province, Mindanao Island.
Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.

Cabudlungan, Iwahig Penal Colony, Palawan Province, Palawan Island.
Caburan, Caburan Municipality, Davao Province, Mindanao Island.
Caburan Municipality, Davao Province, Mindanao Island.
Cagayan (town), Cagayan Municipality, Misamis Oriental Province, Mindanao Island.
Cagayan Municipality, Misamis Oriental Province, Mindanao Island.
Calamianes group, Coron Municipality, Palawan Province.
Calian (also known as Kalian), Malita Municipality, Davao Province, Mindanao Island.
Canigaran, Puerto Princesa Municipality, Palawan Province, Palawan Island.
Cañon Island, Puerto Princesa Municipality, Palawan Province.
Capilit Cave, near Upi, Mount Cabalata Municipality, Cotabato Province, Mindanao Island.
Carmelita, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.
Casuyan, Iwahig Penal Colony, Palawan Province, Palawan Island.
Central Cave, Cotabato City, Cotabato Municipality, Cotabato Province, Mindanao Island.
Centro, Cuyo Island, Cuyo group, Palawan Province.
Conel, Buayan Municipality, Cotabato Province, Mindanao Island.
Coron (town), Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.
Coron Municipality, islands of Calamianes group, Palawan Province.
Cotabato (city), Cotabato Municipality, Cotabato Province, Mindanao Island.
Cotabato Province, Mindanao Island.
Cotcot (est. 6,500 ft. elev.), Mount Data, Mountain Province, Luzon Island.
Crater Lake Camp (*ca.* 9,000 ft. elev.), Crater, Mount Apo, Davao Province, Mindanao Island.

Culaman, Caburan Municipality, Davao Province, Mindanao Island.
Culion Island, Coron Municipality, Calamianes group, Palawan Province.
Culion Leper Colony, Culion Island, Coron Municipality, Calamianes group, Palawan Province.
Cuyo (town), Cuyo Island, Cuyo group, Palawan Province.
Cuyo Island, Cuyo group, Palawan Province.

Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.
Davao City, Davao City Province, Mindanao Island.
Davao City Province (an incorporated area with rank of province), Mindanao Island.
Davao Province, Mindanao Island.
Del Monte, Bukidnon Province, Mindanao Island.
Digos, Santa Cruz Municipality, Davao Province, Mindanao Island.
Dimaniang, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.

Esperanza, Iwahig Penal Colony, Palawan Province, Palawan Island.

General Luna, Iwahig Penal Colony, Palawan Province, Palawan Island.

Halang, Naic Municipality, Cavite Province, Luzon Island.

Icadambanauan Island, off northeastern Palawan, Palawan Province.
Imulnud, Brooke's Point Municipality, Palawan Province, Palawan Island.
Iwahig and/or (=) Iwahig Penal Colony, Palawan Province, Palawan Island.

Kabaksalan, Pikit Municipality, Cotabato Province, Mindanao Island.
Kabelnekan (*ca.* 1,400 ft. elev.), Mantalingajan Range, Brooke's Point Municipality, Palawan Province, Palawan Island.
Kainay, Abra Province, Luzon Island.
Kalian; see Calian.
Kamansi, Mati Municipality, Davao Province, Mindanao Island.
Katagatan (*ca.* 1,300 ft. elev.), Mantalingajan Range, Brooke's Point Municipality, Palawan Province, Palawan Island.
Kidapawan (town; new site), Kidapawan Municipality, Cotabato Province, Mindanao Island.
Kidapawan Municipality, Cotabato Province, Mindanao Island.
Kitituan, near Kidapawan (town), Kidapawan Municipality, Cotabato Province, Mindanao Island.
Klaja, near Conel, Buayan Municipality, Cotabato Province, Mindanao Island.

Lacaron, Malita Municipality, Davao Province, Mindanao Island.
Lagao, Buayan Municipality, Cotabato Province, Mindanao Island.
Lagaoriao, Cuyo Island, Cuyo group, Palawan Province.
Laguna Province, Luzon Island.
Lakandula, Iwahig Penal Colony, Palawan Province, Palawan Island.
Lake Linau (7,800 ft. elev.), north slope of Mount Apo, Davao Province, Mindanao Island.
Lapuan, Malita Municipality, Davao Province, Mindanao Island.
Lapulapu, Iwahig Penal Colony, Palawan Province, Palawan Island.
Las Baños, Laguna Province, Luzon Island.
Lawa, Malita Municipality, Davao Province, Mindanao Island.

Libby (Airfield), Davao City Province, Mindanao Island.
Libertad, Iwahig Penal Colony, Palawan Province, Palawan Island.
Libuganon, Tagum Municipality, Davao Province, Mindanao Island.
Licuan, Abra Province, Luzon Island.
Liguasan Marsh, Liguasan Municipality, Cotabato Province, Mindanao Island.
Liguasan Municipality, Cotabato Province, Mindanao Island.
Luangbay Cave; see Sitio Tegato.
Lungsod, Cuyo Island, Cuyo group, Palawan Province.

Maco, Tagum Municipality, Davao Province, Mindanao Island.
Madaum, Tagum Municipality, Davao Province, Mindanao Island.
Magallanes, near Digos, Davao Province, Mindanao Island.
Magupo, near Madaum, Tagum Municipality, Davao Province, Mindanao Island.
Mahupa, Culion Island, Coron Municipality, Calamianes group, Palawan Province.
Mainit, Brooke's Point Municipality, Palawan Province, Palawan Island.
Mainit Camp (4,300 ft. elev.), east slope of Mount Apo, Davao Province, Mindanao Island.
Makinis, Culion Island, Coron Municipality, Calamianes group, Palawan Province.
Malabutuan (also known as Marabutuan), Caburan Municipality, Davao Province, Mindanao Island.
Malagdas, Iwahig Penal Colony, Palawan Province, Palawan Island.
Malalag, Santa Cruz Municipality, Davao Province, Mindanao Island.
Malamig, Iwahig Penal Colony, Palawan Province, Palawan Island.
Malasila, Kidapawan Municipality, Cotabato Province, Mindanao Island.
Malita Municipality, Davao Province, Mindanao Island.
Mallu, near Dadiangas, Buayan Municipality, Davao Province, Mindanao Island.
Mamalod, near Calian, Malita Municipality, Davao Province, Mindanao Island.
Mantalingajan Range, Brooke's Point Municipality, Palawan Province, Palawan Island.
Marabutuan; see Malabutuan.
Masigit Marsh, Pikit Municipality, Cotabato Province, Mindanao Island.
Massisiat, Abra Province, Luzon Island.
Mati (town), Mati Municipality, Davao Province, Mindanao Island.
Mati Municipality, Davao Province, Mindanao Island.
Matutungan (est. 2,500 ft. elev.), Santa Cruz Municipality, Davao Province, Mindanao Island.
Mauyon, near Babuyan, Puerto Princesa Municipality, Palawan Province, Palawan Island.
Mayo, Mati Municipality, Davao Province, Mindanao Island.
Meran Camp (6,000 ft. elev.), east slope of Mount Apo, Davao Province, Mindanao Island.
Midsayap (town), Midsayap Municipality, Cotabato Province, Mindanao Island.
Midsayap Municipality, Cotabato Province, Mindanao Island.
Misamis Oriental Province, Mindanao Island.
Montible, Iwahig Penal Colony, Palawan Province, Palawan Island.
Mount Apo, Davao Province, Mindanao Island.
Mount Balabag, Mantalingajan Range, Brooke's Point Municipality, Palawan Province, Palawan Island.
Mount Batuan, Caburan Municipality, Davao Province, Mindanao Island.
Mount Busaw, Caburan Municipality, Davao Province, Mindanao Island.
Mount Data, Mountain Province, Luzon Island.

Mount Kapiligan (also called Mount Kapilingan), Mountain Province, Luzon Island.
Mount Makiling (often spelled Maquiling), Laguna Province, Luzon Island.
Mount McKinley, Davao Province, Mindanao Island.
Mount Pantod, near Tagabuli, Santa Cruz Municipality, Davao Province, Mindanao Island.
Mount Tacob, Caburan Municipality, Davao Province, Mindanao Island.
Mountain Province, Luzon Island.

Namalnawan, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.
Nañgi, Upi Municipality, Cotabato Province, Mindanao Island.
Neto, Buayan Municipality, Cotabato Province, Mindanao Island.

Olimpog, near Dadiangas, Cotabato Province, Mindanao Island.

Paidu-Pulangi, Silik Municipality, Cotabato Province, Mindanao Island.
Palawan Island, Palawan Province.
Panacan, Aborlan Municipality, Palawan Province, Palawan Island.
Pangawaran, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.
Parang (town), Parang Municipality, Cotabato Province, Mindanao Island.
Parang Municipality, Cotabato Province, Mindanao Island.
Peñaplata, Samal Island, Davao Gulf, Samal Municipality, Davao Province.
Pikit (town), Pikit Municipality, Cotabato Province, Mindanao Island.
Pikit Municipality, Cotabato Province, Mindanao Island.
Puerto Princesa (town), Puerto Princesa Municipality, Palawan Province, Palawan Island.
Puerto Princesa Municipality, Palawan Province, Palawan Island.
Pulangi River, Pikit and Liguasan Municipality, Cotabato Province, Mindanao Island.

Quinawitnan, Samal Island, Davao Gulf, Samal Municipality, Davao Province.

Ramasamey Island, Puerto Princesa Municipality, Palawan Province.

Sadsapan, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.
Samal Island, in Davao Gulf, Samal Municipality, Davao Province.
San Carlos, Cuyo Island, Cuyo group, Palawan Province.
San Nicolas, near Coron town, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.
San Pedro, Culion Island, Coron Municipality, Calamianes group, Palawan Province.
Santa Ana, suburb of Davao City, Davao City Province, Mindanao Island.
Santa Cruz Municipality, Davao Province, Mindanao Island.
Santa Teresa, Iwahig Penal Colony, Palawan Province, Palawan Island.
Santiago, Iwahig Penal Colony, Palawan Province, Palawan Island.
Sibulan (*ca.* 1,000 ft. elev.), base of Mount Apo, Davao Province, Mindanao Island.
Sikatuna, Iwahig Penal Colony, Palawan Province, Palawan Island.
Silik, Silik Municipality, Cotabato Province, Mindanao Island.
Silik Municipality, Cotabato Province, Mindanao Island.
Sinaksakan, near Todaya, Mount Apo, Davao Province, Mindanao Island.

Sinamay, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.

Singay and/or Singay Manganese Mines, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.

Sitio Taglawig, near Maco, Tagum Municipality, Davao Province, Mindanao Island.

Sitio Tegato (Luangbay Cave), Davao City Province, Mindanao Island.

Siuk, Culion Island, Coron Municipality, Calamianes group, Palawan Province.

Sorsogon, Iwahig Penal Colony, Palawan Province, Palawan Island.

Sputon, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.

Sudu, near Meran, Mount Apo, Davao Province, Mindanao Island.

Tagabuli, Santa Cruz Municipality, Davao Province, Mindanao Island.

Tagbuni, Iwahig Penal Colony, Palawan Province, Palawan Island.

Taglawig, Sitio; see Sitio Taglawig.

Tagum Municipality, Davao Province, Mindanao Island.

Talikud Island, Davao Gulf, Samal Municipality, Davao Province.

Tamalpulan Island, Coron Municipality, Calamianes group, Palawan Province.

Tanabog, Babuyan area, Puerto Princesa Municipality, Palawan Province, Palawan Island.

Tanog, near Dadiangas, Buayan Municipality, Cotabato Province, Mindanao Island.

Tawang Cave at Quinawitnan, Samal Island, Davao Gulf, Samal Municipality, Davao Province.

Taytay, Malita Municipality, Davao Province, Mindanao Island.

Tegato, Sitio; see Sitio Tegato.

Tigoplan, Brooke's Point Municipality, Palawan Province, Palawan Island.

Tigoplan River, Mantalingajan Range, Brooke's Point Municipality, Palawan Province, Palawan Island.

Tindog-Bato (est. 2,000 ft. elev.), Santa Cruz Municipality, Mindanao Island.

Tipunan, Mount Data (est. 5,500 ft. elev.), Mountain Province, Luzon Island.

Todaya (2,800 ft. elev.), Mount Apo, Davao Province, Mindanao Island.

Tuganay, Tagum Municipality, Davao Province, Mindanao Island.

Tulawa, Busuanga Island, Coron Municipality, Calamianes group, Palawan Province.

Ugis-Aya Plantation (beside 3,000 ft. camp), Mount McKinley, Davao Province, Mindanao Island.

Upi, Upi Municipality, Cotabato Province, Mindanao Island.

Upi Municipality, Cotabato Province, Mindanao Island.

ITINERARY OF EXPEDITION

During the course of the expedition, several parties were in different places in the field or coming or going from the various base camps for various periods. For this reason a locality itinerary has been outlined by provinces, under the name of the island or island group, in as close calendar order as possible. The island, province, and municipality of any collecting locality found on the expedition labels can be ascertained by referring to the list of localities (p. 16).

Names of expedition members participating in each trip are listed.

LUZON

MOUNTAIN PROVINCE

Personnel: Rabor, Celestino, Castro, Rabanal, and Alcasid.

Localities: Mount Data, including Cotcot and Tipunan; Mount Kapiligan; and Baguio.

April 2–May 5, 1946.

ABRA PROVINCE

Personnel: Rabor, Celestino, Castro, Rabanal, and Alcasid.

Localities: Massisiat; Baay; Licuan.

May 10–28, 1946.

LAGUNA PROVINCE

Personnel: Werner.

Localities: Las Baños; Mount Makiling.

May 28–June 5, 1947.

MINDANAO ISLAND

Personnel: Hoogstraal, Heyneman, Werner, Celestino, Castro, Edaño, Alcasid, Añonuevo, and Convocar.

PROVINCES OF MISAMIS ORIENTAL AND BUKIDNON

Small collections were made in the vicinity of Cagayan, Misamis Oriental; just above Agusan, Bukidnon; and at Del Monte, between

July 25–30, 1946, while our boat, en route from Manila to Davao City, lay at anchor at the Cagayan dock.

DAVAO CITY PROVINCE

The Mindanao Island Permanent Base Camp was maintained at Davao City from August 4, 1946, to February 24, 1947. Collections were made in Davao City, including the suburbs of Santa Ana and Bankarohan.

At Sitio Tegato (Luangbay Cave) collections were made by Hoogstraal, Heyneman, and Celestino on October 22, 1946.

LOWLANDS OF DAVAO PROVINCE

In Tagum Municipality, collections were made in Madaum, Libuganon, Busaon, and Magupo, by Werner, Alcasid, Castro and Edaño, October 8–20, 1946, and by Castro, October 20–November 3 and November 20–31; at Tuganay, by Castro, November 20; and at Maco and Sitio Taglawig, by Hoogstraal, Heyneman, Celestino, and Añonuevo, October 9–19.

In Mati Municipality, including Mati, Mayo, Kamansi, and Parombon, collections were made by Convocar, December 23, 1946–January 14, 1947.

In Santa Cruz Municipality, collections were made at Malalag by Werner and Castro, November 27–29, 1946.

In Malita Municipality, collections were made at Lacaron by Werner and Castro, February 3–10, 1947, and at Lawa by Celestino and Oañe, December 27–29, 1946.

Collections were made at Calian, including Lapuan and Taytay, by Celestino and Oañe, December 29, 1946–January 30, 1947.

In Caburan Municipality, including Culaman, Caburan, Malabutuan, Mount Batuan, Mount Busaw, and Mount Tacob, collections were made by Hoogstraal, January 8–28, 1947, and by Oañe and Añonuevo, February 12–21, 1947.

HIGHLANDS OF DAVAO PROVINCE

Mount McKinley

Collections were made by the entire party as follows: at 3,300-foot (base) camp, August 9–October 6, 1946; at 2,800-foot (valley) camp, August 17–23; at 5,200-foot camp, August 18–September 1 and September 28–October 2; at 6,400-foot camp, September 1–12; and at 7,200-foot camp, September 9–30.

Mount Apo

Collections were made by the entire party as follows: at Todaya Village camp, 2,800 feet, October 17–November 23; at Lake Linau camp (north slope), 7,800 feet, October 27–November 5; at Meran camp (east slope), 6,000 feet, November 3–10; at Baclayan camp (east slope), 6,500 feet, November 9–17; at Baclayan River (sulfur fumarole) camp (east slope), 7,700 feet, November 12–18; at Crater camp, Crater Lake, 9,000 feet, November 14–17; and at Mainit camp (east slope), 4,300 feet, November 17–21.

Highlands of Santa Cruz Municipality

Collections were made by Celestino as follows: at Badiang (est. 2,000 feet), at Matutungan (est. 2,500 feet), at Mount Pantod (est. 2,500 feet), and at Tindog-Bato (est. 2,000 feet), December 9–16, 1946.

COTABATO PROVINCE

Small collections were made at Parang, Parang, on August 2 and 3, 1946, when our boat stopped there en route to Davao City from Manila.

Northern Cotabato Province

Werner, Alcasid, Edaño, and Añonuevo left Davao City on December 1, 1946, arriving at Pikit on December 14, where they collected in Masigit Marsh. They also collected in Liguasan Marsh as far south as Buluan, December 18–23, arriving at Cotabato City on December 24, and at Upi on December 31. They collected at Upi, Nañgi, Burungutan, and Burungkôt for several days, leaving on January 11, 1947.

Southern Cotabato Province (Buayan Municipality)

Hoogstraal and Castro left Davao City and arrived in Buayan on December 5, 1946. They collected at Buayan, Dadiangas, and Lagao, December 5–9, and at Conel, including Klaja, December 9–18, 1946.

Castro collected at Conel, Balcayo, Namalnawan, Olimpog, Sadsapan, and Sputon until December 21, 1946, and at Buayan and the near-by localities of Akbul, Beto, Bugad, Bula, Calungkingad, Mallu, Neto, Sputon, and Tanog from January 7 to 30, 1947.

PALAWAN ISLAND AND ADJACENT ISLANDS

Personnel: Hoogstraal, Werner, Rabor, Celestino, Castro, Añonuevo, Oañe, Edaño.

Major Howard T. Wright and his staff, stationed at Puerto Princesa, and Mr. Barney French of Iwahig added many specimens to our collections.

PALAWAN ISLAND (INCLUDING CAÑON, RAMASAMEY, ICADAMBANAUAN, AND ARENA ISLANDS)

Puerto Princesa Municipality

The permanent Palawan Province Base Camp was established on the beach several kilometers west of Puerto Princesa town on March 8, 1947, and was maintained by various members of the expedition until May 25.

Collecting stations in Babuyan-Bacungan area: Babuyan, March 14–22; Mauyon, March 20; Tanabog (elev. 1,400 feet), March 17; Bacungan, March 23–31. Bats and sea birds were collected on Cañon Island, a tiny mangrove sand spit just north of Puerto Princesa Bay, on April 17. Birds were also collected on nearby Ramasamey Island on the same day. Collecting personnel were Werner, Castro, Edaño, and Oañe.

Iwahig Penal Colony

Temporary camps were maintained at Iwahig Penal Colony by various members of the expedition, and specimens were obtained from there during the entire length of our stay in Palawan Province. Other collecting places visited during the course of these activities were Baguio, Banaag, Binuan, Cabudlungan, Casuyan, Esperanza, General Luna, Iwahig (Colony headquarters), Lakandula, Lapulapu, Libertad, Malagdas, Malamig, Montible, Santa Teresa, Santiago, Sikatuna, Sorsogon, and Tagbuni, all in Iwahig.

Brooke's Point Municipality

Camp was established in the village of Brooke's Point on April 23, 1947, by Werner, Rabor, Celestino, Oañe, and Edaño, and maintained there by one or more of these members, when not elsewhere in this municipality, as noted below, until May 16. On May 14, Rabor joined the party that touched here en route to Balabac Island. All collections, except as noted below, are from the immediate vicinity of the village of Brooke's Point.

On April 27, Werner, Oañe, and Edaño departed for Mount Balabag in the Mantalingajan Range, collecting en route and at the following points on Mount Balabag: Imulnud (elev. about 150 feet), April 27 and 28; Tigoplan (elev. about 180 feet), April 28–May 2; Tigoplan River Valley and Mainit (elev. from 500 to 2,000 feet), May 1–3; Kabelnekan (elev. about 1,400 feet), May 2; Katagatan (elev. about 1,300 feet), May 4; south slope of Mount Balabag, where collecting stations were established between 2,800 and 5,000 feet elevation.

A few specimens were taken near the village of Bonobono by Hoogstraal and N. Ferrar, an agricultural inspector, on May 16, while en route from Balabac Island to Puerto Princesa.

Aborlan Municipality (Arena Island)

Werner and Rabor collected a series of rodents and birds on Arena Island on April 2, while their boat, en route to Brooke's Point, was at anchor. Hoogstraal and Werner collected insects at Panacan on May 17.

Icadambanauan Island

Hoogstraal collected invertebrates on April 5, while en route from the Calamianes to Puerto Princesa.

CALAMIANES ISLAND GROUP

Personnel: Hoogstraal, Rabor, Celestino, and Añonuevo.

Busuanga Island

Collecting stations: Coron, March 23 and 24; San Nicolas, March 13; Singay Manganese Mines, March 13, 24, and 25; Dimaniang and the following near-by points: Bintuan, Carmelita, Pangawaran, Sinamay, Tulawa, March 14–22.

Culion Island

Arrived at Culion Island Leper Colony Headquarters on March 25. Hoogstraal and Añonuevo departed for Palawan on April 3, Rabor and Celestino on April 10. Camp was established on March 25 and broken on April 2 at San Pedro, and the following near-by points were visited and collections made: Aborabod, Makinis, and Mahupa. At Siuk, camp was established on April 3 by Rabor and Celestino, and broken on April 10.

Tamalpulan Island

A single bird and a few invertebrates were collected by Hoogstraal on April 4, while en route to Puerto Princesa.

BALABAC ISLAND GROUP

Collections were made in the vicinity of Balabac town on Balabac Island for fourteen hours, May 15, 1947, by Hoogstraal, Rabor, and Añonuevo.

CUYO ISLAND GROUP

Collections were made by Castro and Añonuevo in the vicinity of Cuyo town on Cuyo Island, and in the near-by hamlets of Lagaoriao, Lungsod, San Carlos, and Bataguen, May 24–30.

SUMMARY OF SPECIMENS COLLECTED BY EXPEDITION

	Amphibians and reptiles	Birds	Mammals	Totals
Luzon				
Mountain Province	24	85	450	559
Abra Province	24	473	29	526
Mindanao				
Lowlands	1054	509	843	2406
2,000–9,690 feet	946	522	356	1824
Palawan and adjacent islands				
Lowlands	929	766	998	2693
1,000–5,000 feet	70	7	110	187
Totals	3047	2362	2786	8195

	Amphibians and reptiles
Caecilians	21
Frogs and toads	1806
Lizards	720
Snakes	348
Turtles	55
Crocodiles	12
Miscellaneous	85
Total	3047

About four hundred fishes, mostly from fresh water, are not listed in the summary.

An estimated two hundred thousand insects and other invertebrates were collected. When possible, specialized collections for specific groups were made, but as a general rule the collecting of vertebrates took precedence. Efforts were made to get as complete a representation of ectoparasites as possible. Werner collected several thousand specimens of ptilid beetles.

OPERATIONS ON LUZON ISLAND

Mountain Province

The high mountain mass of northern Luzon, lying just north of the fertile plains of central Luzon, is roughly delimited by the borders of Mountain Province (see fig. 2). To the biologist, Mountain Province is a fascinating area because of its unusual number of remarkable and endemic genera of rodents, and because it presents the only extensive area of temperate vegetation in the Philippine Islands.

The typical tree throughout the region is *Pinus insularis*, found only here and in a very limited portion of western Mindoro. The mountain area, apparently of recent origin, was originally a vast plateau, now much dissected by the extremely heavy rains. Along the road between Trinidad Valley, just outside of Baguio, and Mount Data, the area is one of considerable uniformity, characterized by long and often parallel north-south hogbacks and well-eroded V-shaped valleys that probably never drop below 4,000 feet elevation. Ranges are often connected by saddles.

Extensive logging is carried on throughout the area and the resulting erosion is considerable. Innumerable patches are cleared and burned by the Igorots for short term *camote* gardens. The fertile Trinidad Valley supplies much of the vegetable produce for the Manila market, and the near-by gold mines have been in large part responsible for the great economic wealth of the Philippines. Malaria, which before the war was restricted to foothill areas of the Philippines, has apparently become established to at least a limited degree in Trinidad Valley and certain other localities in Mountain Province. A few specimens of *Anopheles minimus flavirostris*, the chief vector, have been taken in irrigation ditches there since the war. It is recognized throughout the Philippines that the tremendous movement of peoples during the war, especially into previously uninhabited areas, has spread malaria into lowland and highland areas where it has never before been recorded, and that it is being maintained to some extent either by marginal populations of the chief vector or by vectors of secondary importance.

During the dry season, which lasts from November to late May, the climate of Baguio is always pleasantly cool, and rains are infrequent. During the rainy season, the rains are heavy and incessant. The record for greatest rainfall in the world for a single day was made at Baguio. The temperature at Mount Data, about 2,000 feet higher, is some degrees lower and the winds at night make a warm sleeping bag much appreciated.

In spite of our lack of equipment, the expedition's Mountain Province operations were hastened, to take advantage of the last of the dry season, and they were entirely in the hands of the Filipino staff. Lieutenant Heyneman and I were able to visit the Mount Data camp for observation for a week and for three days respectively, and the account of the local flora is a result of our notes. After this visit to Mount Data, we collected insects for a day or two at Baguio.

MOUNT DATA AND MOUNT KAPILIGAN[1]

Mount Data, the type locality for Whitehead's astonishing collections of endemic genera of rodents (1893 and 1895), reaches an altitude of about 8,000 feet, almost the highest point in Mountain Province. The peak is unique because of its flat plateau (about three miles long), which supports a well-developed mossy forest. The outer or western slope extends into the lowlands of Lapanto, and is apparently the area worked by Whitehead. The inner or eastern slopes, transected by the highway at some 7,000 feet, end in a partly cultivated valley at some 5,500 feet, and are the principal areas worked by our party. The party, headed by Dioscoro S. Rabor, collected on these slopes from April 2 to May 4, 1946.

The mossy forest on the summit consists largely of oaks (*Quercus* spp.) and mountain yews (*Taxus wallichiana* Zucc.), together with several other hardwoods and tree ferns. The forest is dark and dense, and most of the trees are dwarfed and shrubby. Ground ferns comprise most of the low vegetation. Bushes and small trees are often heavily entwined by vines and rattan. A heavy growth of moss covers the trees and the ground, together with a considerable variety of ferns, liverworts, lichens, epiphytic orchids, and other herbaceous plants. The soil is rich with wet, woody matter and rotting leaves.

The summit forest ends abruptly at the edge of the plateau, except along the several steep watercourses, where a ravine forest somewhat similar to that of the summit persists down to about 5,500 feet. The herbs and shrubs of the ravine forests are consider-

[1] From notes of Harry Hoogstraal and Donald Heyneman.

FIG. 2. Luzon, showing localities at which the expedition collected.

ably more numerous than those of the summit, making the ravines difficult to penetrate; the moss and epiphytes gradually diminish as altitude is lost.

The pine forest of the slopes is parklike in aspect, and the grass cover is thick almost everywhere, though considerably thicker above the road than below it. Bracken fern and a few composites are found among the grass. Patches burned for *camote* plantings are frequent. Invertebrate collecting was markedly poor here.

The narrow Nabilnagan River Valley at the base of Mount Apo, about 5,500 feet elevation, is cultivated, with several tiers of rice paddies reached by irrigation ditches. Some parts of the valley are swampy. All trees have long since been removed and the non-cultivated areas are overgrown with grass and Compositae.

Mount Kapiligan (also known as Mount Kapilingan) is just opposite Mount Data and joined with it by a connecting ridge. It is apparently less frequented by Igorots than Mount Data, for the giant rats (*Crateromys* and *Phloemys*) persist there, though they have been exterminated from Mount Data.

In May the party moved to Kilometer 96 on the road, at a place known locally as Cotcot, and collected here and at Kilometer 100, halfway between their new and old stations. Mr. Rabor tells us that this area (about 6,500 feet elevation), on the far east side of Mount Data, is a mixture of pine forest and extensive grasslands resulting from logging and burning.

Abra Province[1]

About May 10, 1946, the collecting party, composed of the same personnel as the Mountain Province party, established camp at the Rest House at Massisiat, about 45 kilometers from the Abra provincial capital, Bangued, and about 80 kilometers from the west coast of Luzon (see fig. 2).

The area collected ranges in elevation from 1,900 to 5,000 feet above sea level and includes five vegetational types: primary dipterocarpous forest; mixed second growth and bamboo; rain forest; pine forest; and open grassland areas.

In the lower localities, around Baay and on the lower mountain slopes, from 1,500 to 2,500 feet above sea level, the forest is primary *Dipterocarpus*, chiefly the following species: *anisoptera*, *pentacme*, *hopea*, *shorea*, and *vatica*.

[1] From notes of Dioscoro S. Rabor.

The vicinity immediately surrounding the camp site is mixed second growth and bamboo thickets (*Schizostachyum* sp.). The bamboo forms dense clusters on the hillside, with large intervening patches of open grassland, and in these patches there are also areas of low second growth forest and smaller remnants of primary dipterocarpous forest. The steep hillsides are covered with dense thickets and this growth extends downward in the valley between the hills. Banyan and balete trees (*Ficus* spp.) abound in the area, and are favorite feeding trees for birds.

Rain forest predominates higher in the mountains, and consists of tall and lower trees, dense shrubs, herbs, ferns, and rattan. Bird life is impoverished in this area.

Grasslands exist above the rain forest on the mountains, and pines, either singly or in small stands, dot the scene. Carabao and cattle roam wild in bands in these grasslands, and constitute a menace to persons who venture among them.

Work in this area was completed on May 28, 1946.

Laguna Province[1]

A short collecting trip was made in Laguna Province between May 28 and June 5, 1947, by Werner, chiefly for the purpose of collecting insect topotypes, while the rest of the expedition personnel were winding up various details in Manila. He lived on the grounds of the University of the Philippines Agricultural College and School of Forestry at Las Baños, and collected in this area as well as on the slopes of near-by Mount Makiling. The mountain has two peaks separated by a valley. The higher of the peaks (elevation about 4,000 feet) has an area of mossy forest considerably larger than that of the lower peak.

Cavite Province

We did not visit Cavite Province, but Dr. Marcos Tubangui of the Bureau of Science in Manila presented us with three specimens of the island painted quail (*Excalfactoria chinensis*) and the Philippine button quail (*Turnix suscitator fasciata*) from Halang, Naic, Cavite. This spot is not far from the road between Manila and the Cavite Naval Base, a little more than an hour's drive southwest from Manila. We understand from Doctor Tubangui that this

[1] From notes of F. G. Werner.

area is one of extensive grassland and that this little quail, which he is using for malaria experiments, is quite common and easily obtained there.

OPERATIONS ON MINDANAO ISLAND

Mindanao Island is second only to Luzon in size in the Philippine archipelago. Its eastern portion (that is, exclusive of the Zamboanga Peninsula) is the largest compact land mass in the island group. The rugged peninsula consists of a great north-south mountain range. Zamboanga, at its southern tip, is the only town of importance. A number of the faunal elements of the peninsula differ from those of the rest of the island. Mount Malindang, near the northern end, rises to some 9,000 feet and is the second largest mountain, and possibly the oldest, on the whole island. In early Pleistocene times, the peninsula was probably separated from the remainder of Mindanao. At the southern tip, Basilan Island supports a fauna in part endemic. To the south, forming important stepping stones for Malayan and Bornean faunal elements, the Sulu Archipelago extends in an almost straight line between Borneo and the Zamboanga Peninsula. Unfortunately we were unable to explore this group of islands and the peninsula, but a small collection made by the Crane Pacific Expedition in 1929 is available in Chicago Museum.

The compact eastern mass of Mindanao is composed, in the north, from west to east, of the provinces of Misamis Oriental, Lanao, Bukidnon, Agusan, and Surigao. We touched, very briefly, in the first and third of these provinces. The northwestern part of the island is a plateau covered by more or less sparse grass and much dissected by deep, heavily forested ravines. There are also high, completely unexplored mountains in the area, and commercial and military aviators have repeatedly told me that one or two of those in the region of Lake Lanao are well over 10,000 feet in altitude. Between the western section and the also unexplored Diuata Mountains of Surigao on the northeast coast lies the marshy valley of the Agusan River. Apparently the Bukidnon-Lanao uplands and the mountains of Agusan and Surigao were separate islands in early Pleistocene times.[1] The uplands of Agusan and Surigao extended into the southern part of the present island, but those of Lanao

[1] R. E. Dickerson, *Distribution of Life in the Philippines*. Manila, 1928.

and Bukidnon were separate from the Cotabato Islands, which form the southwestern part of the great eastern mass of present-day Mindanao.

The southern part of Mindanao is composed of Cotabato Province in the west, and Davao and Davao City Provinces in the east (see fig. 3). Our expedition worked a number of lowland localities of Cotabato, but unfortunately could not reach those of the southwestern coast, where certain animals, such as the shrew, *Crocidura parvacauda*, are apparently localized on the eastern Mindanao land mass. The highlands and lowlands of Davao and Davao City Provinces west of Davao Gulf received extensive and intensive attention from our group. Small series of the fascinating and important vertebrate fauna of Davao Province had previously been taken by various American and European collectors, and it was our purpose to obtain more extensive collections on which to base a more adequate knowledge of this fauna. High mountain ranges, unexplored and unmapped, border the coasts of Cotabato and Davao. Between these ranges the marsh and lake country of Cotabato, also sparsely inhabited, extends to almost the southern end of the island. The fertile Koronadal plains of southern Cotabato, around Sarangani Bay, support a heavy population.

Economically, Mindanao is important for the production of hemp, copra, ramie, rattan, rubber, corn, rice, lumber, grazing, fishing, pearls, shells, copal, and gold, and these resources are by no means fully developed.

The mean annual minimum temperature for Davao City is 18.7° C., the annual normal is 26.9° C., and the mean annual maximum is 35.4° C. These figures are about 0.5° C. higher for Cotabato City. All but the northern end of Mindanao Island is out of the typhoon belt. The great south-central mass of the island, with which the Mindanao section of this report is chiefly concerned, is an intermediate seasonal type, with no very pronounced dry and rainy season; 2,290 mm. is the annual average rainfall at Davao City, and 2,272 mm. at Cotabato City. Inhabitants in one place or another recognize some degree of dry or rainy seasons. These of course vary considerably with exposure to winds and relation to mountain masses. The usual stories of "unseasonal weather" greet one in Mindanao as everywhere, and it is difficult to form any but a general idea of the climate and rainfall during the course of one year's stay. Along Davao Gulf a map spotted with the locations of good hemp plantings would probably be equivalent

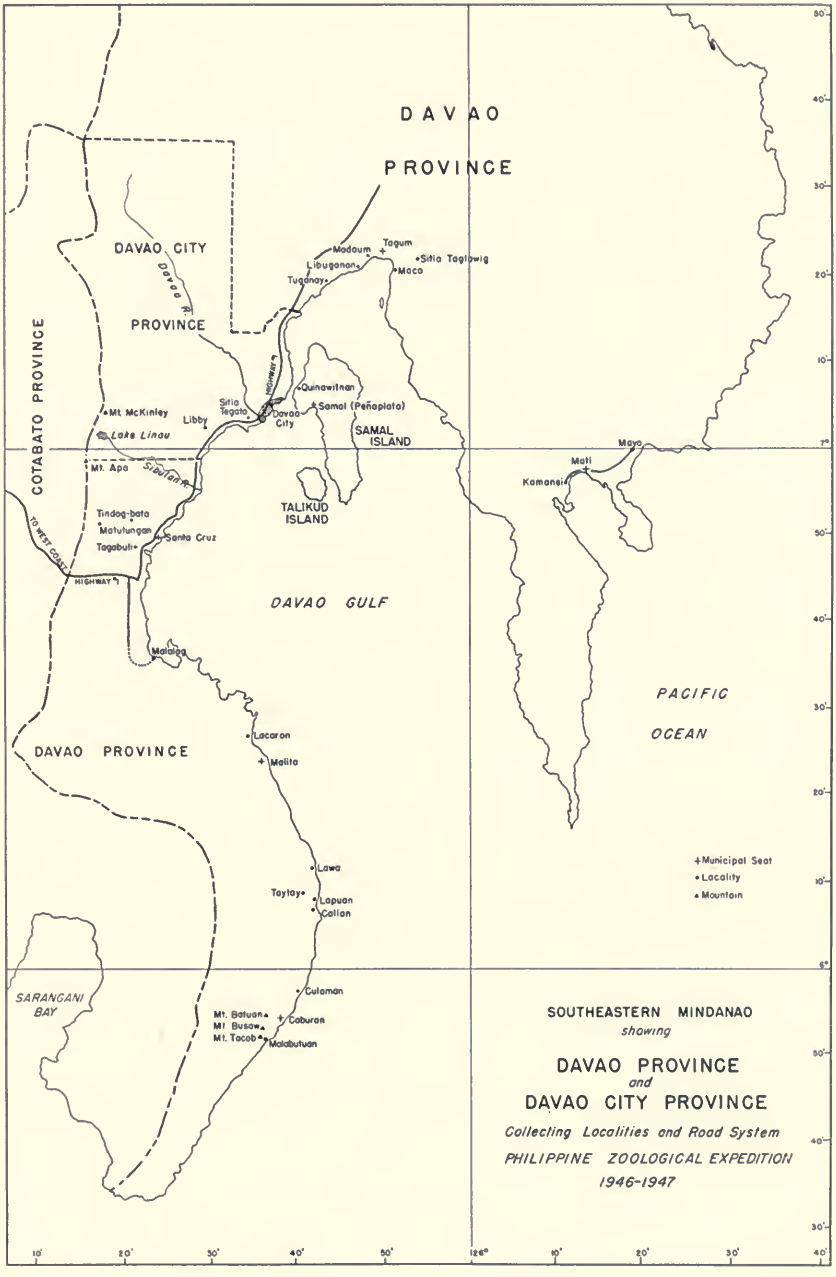

FIG. 3. Southeastern Mindanao, showing localities at which the expedition collected.

to a map of that area indicating those parts that receive rain the year around.

Misamis Oriental and Bukidnon Provinces[1]

Localities in these provinces were visited by expedition members, except Werner, who had not yet arrived from the United States, between July 25 and 30, 1946, while our boat, en route from Manila to Davao City, discharged and took on cargo at the Cagayan dock. A few months previous to this, I had traveled extensively in these provinces and made small collections that are now in Chicago Natural History Museum. Cagayan can be reached by road from southern Mindanao when Moro disturbances in Lanao Province do not close this section. Formerly a road ran east and west out of Cagayan along the North Coast of the island but it is now impassable westward out of Cagayan and extends eastward only to Bugo. Just before it reaches Bugo the road turns south and climbs sharply through narrow scrubby ravines to the grassy Bukidnon plateau (elevation about 2,000 feet). This is the Sayre highway, which once ran to the south end of the island but is now passable only as far as Malaybalay. We did some collecting at Del Monte, Bukidnon, and in the near-by grasslands. Just above the village of Agusan we made a collection of frogs and insects from a swift rocky stream, and we also collected frogs and snakes at night in and about the streams near the town of Cagayan.

Davao City Province

DAVAO CITY

We arrived at Davao City by boat from Manila on August 4, 1946, and were invited by the United States Army Enemy Property Custodian to make our headquarters in his *bodega*, which we used as our base camp until our final departure from Mindanao in February, 1947.

Davao City is a frontier town bustling with activity and commerce (see pl. 2). The port, on Davao Gulf at Santa Ana, a suburb of the city, is rather exposed to the elements and a new, more protected deep-water dock is planned for Sasa, eight kilometers north.

Around the city and gulf, the land is grassy or second-growth forest, and there are many overgrown coconut and hemp plantations.

[1] From notes of Harry Hoogstraal and Donald Heyneman.

Inland, one travels over grasslands to the foothills of the Apo range, where some stands of original forest remain among the plantations and second-growth forests. Further inland the country is still primitive. The Davao River, bordered by wide marshes, lies between high banks in a valley from fifty to three hundred feet wide. The river is sluggish during the dry season.

SITIO TEGATO (LUANGBAY CAVE)[1]

Sitio Tegato is a place name given us by our guide, Velencio Pilar, who owns the piece of land we visited. It is reached by turning right at Kilometer 4 on the Davao-Cotabato highway and traveling inland five kilometers on a road made for hauling timbers. The trip was made on October 22, 1946, by Hoogstraal, Heyneman, and Celestino, together with Pilar, for the purpose of collecting bats from Pilar's cave, to which he gave the name of Luangbay Cave. After leaving the road we walked on a narrow, slippery trail through a dense second-growth forest into a narrow ravine, at the head of which the mouth of the cave opened horizontally before us under the overhanging knob of the hill above. En route to the cave, about two hundred yards from the mouth, we found a single bat hanging about four feet above the ground in a shrub. The main hall of the cave runs straight into the hill for about two hundred yards and then turns downward and branches into a network of smaller tunnels, some of which are blind alleys and mere depressions in the wall. One of the side tunnels circles into the hill and comes out at a different entrance; another branch returns to the main passage. Almost everywhere the sides and lower walls are covered with bat guano.

Thousands of bats squeaked in every available cranny of the cave and many flew about when we disturbed them. The large dog-faced bats (*Rousettus* and *Eonycteris*) were most abundant in crevices high in the main hallways while in the smaller passages a tiny black bat hung on the open walls near the ground. Three species (*Rhinolophus* and *Hipposideros*) with grotesque faces were found in small offshoots of the lateral branches. The largest of these (probably *R. rufus*) usually hung at ten to fifteen foot heights along the wall and ceilings, particularly at the ends of the side tunnels and blind alleys.

A large number of parasitic Diptera and mites, as well as some ticks and fleas, were found on the bats. Many other parasitic

[1] From notes of Harry Hoogstraal and Donald Heyneman.

Diptera were taken crawling on the walls, in the guano, or in flight. A large colony of ants was busily carrying cockroach oothecae along a well-worn trail in the dry guano. Several specimens of a tiny snail and of a distinctly marked click beetle were also taken in guano. Moth larvae that inhabit a flat case were common in the guano and the adults of those we reared were identical with those species taken on the walls of the cave. Several kinds of small Diptera were also common on the walls. A large species of cockroach was abundant in the crevices but camel crickets were rare. We also took a variety of scorpions, millipedes and centipedes in the cave.

Pilar told us that the larger bats in the cave are frequently used for food by near-by residents.

Highlands of Davao Province

We spent eight weeks (August 9 to October 6) on Mount McKinley and five weeks (October 17 to November 23) on Mount Apo. Near-by Mount Washington we did not visit. The range of which these mountains are a part extends from southern Mindanao along Davao Gulf north through Agusan Province into the north end of Mindanao Island.

The Apo range (see pl. 4, fig. 1), as the southern part of this mountain chain is usually called, is unmapped. The names Mount McKinley and Mount Washington appear on no maps that we have seen. We obtained them from a United States Army Intelligence Report on this area, although the name Mount McKinley also appears in Hachisuka's *Birds of the Philippines*. Certain features of Mount Apo and the Apo range now spotted on maps are badly out of place. The location of the peak of Mount Apo, and its elevation, have been established by triangulation by the United States Coast and Geodetic Survey and so are undoubtedly correct.

When viewed from the docks at Santa Ana, Mount McKinley, Mount Washington, and Mount Apo look near-by, the first two closest and green to the top. Mount Apo, to the south and west, looms white as though covered with snow, but the white appearance is due to the boulder fields at its peak. The sulfur fumaroles just below the peak cause a thin cloud of haze that adds to the illusion. When one travels from six to ten kilometers out of Davao City on the Davao-Cotabato highway the view appearing in the photograph (pl. 4, fig. 1) presents itself. Mount McKinley and Mount Wash-

ington are joined with Mount Apo by a saddle 6,000 feet high and some four to five miles in length, and they are connected with each other by a saddle about 7,000 feet high. The two form a huge horseshoe-shaped ridge. The continuation of Mount Washington's ridges to the west of Mount McKinley leaves between the two a huge, steep conical center that gives the impression of an immense crater with one side blown out. These steep interior slopes are considerably drier than the eastern slopes of Mount McKinley, which stop most of the clouds driven in from Davao Gulf. Mount Apo is a tremendous mountain mass rising to 9,690 feet and about a fourth the width of the entire island at this latitude.

Mount McKinley is in line with the winds that blow in from Davao Gulf and its slopes above 4,000 feet are drenched the year around. We visited the mountain in a relatively dry part of the year in the lowlands (there are no pronounced wet and dry seasons), but it rained most of the time, day and night, usually lightly but sometimes very heavily indeed. As might be expected, the moss and epiphyte growth on the trees, and the moss on the ground and on rocks is wonderful to behold. Above 6,400 feet the high winds stunt the forest wherever it is exposed.

Mount Apo, on the other hand, besides offering a much greater variety of habitats, is considerably drier on the east slope. Its north slope approaches that of McKinley in rainfall and in the profuse growth of mosses and epiphytes. Moss is common on the east slope below about 7,000 feet, but not nearly so luxuriant as on the north slope and on Mount McKinley. At 7,000 feet the east slope of Apo becomes increasingly drier, and at our 7,700-foot camp, just below the great sulfur fumarole visible from the lowlands, the vegetation is stunted, thick-leaved, and heath-like. Above this camp, except for certain protected valleys, vegetation disappears except for some grass, huckleberries, and bracken ferns. In the peak craters on the flat ridges at the top the grass is heavier but there are only scattered shrubs and no trees. Trees are said to continue, however, on the north slope, which we did not visit, between 8,000 feet and the summit.

MOUNT MCKINLEY[1]

Sea Level to 3,800 Feet

To reach Mount McKinley, one goes as far as Turil on the Davao-Cotabato road and then turns west and begins the gradual,

[1] From notes of Harry Hoogstraal and Donald Heyneman.

upward climb to the end of the "road," at 3,200 feet elevation. When the roads are dry and one knows how to by-pass the five-foot-deep gullies, the trip can be made in from two to three hours in a jeep or truck. The expedition's first attempt to reach the end of the road took three days, during which time the jeep turned over on its side several times. All forest has been cleared up to 3,000 feet, except in narrow, steep stream valleys. Because of the combination of frequent year-round rains and volcanic soil, fine stands of Manila hemp border the roads on both sides.

On August 9 we first reached our base camp at 3,300 feet. Around the camp was a large grassy clearing, and on the north side the ridge fell steeply for some three hundred feet, and was covered with dense dipterocarpous forest that had been slightly cut over. A small, rapid, rocky creek flowed through the densely shaded forest at the bottom of the narrow valley. The forest down to the creek furnished us with rich collections of invertebrates and herpetological specimens. The forest was of the type common in uninhabited parts of the Philippines; there were many tall trees of considerable variety, numerous shorter trees, and rather few shrubs and herbs. We made a number of collections in the humus and soil, which were particularly rich in phalangids, spiders, small beetles, and crested orthopterans, not to mention small frogs and some small snakes. The stream at the bottom of the hillside contained deep pools, rapids, swift eddies, and quiet ponds, beside many large rocks, and was densely shaded by the trees and shrubs along its bank.

We frequently collected around the camp, for the grassy clearing had a characteristic fauna. Among the most interesting of the insect phenomena was the great variety of Hymenoptera and Diptera that congregated on certain plant leaves and grass stems during much of the day, especially later in the afternoon. We often stood in one spot for half an hour swinging a net and bottling the hymenopterans and flies that came within reach as fast as we could move our hands (see pl. 4, fig. 2). Specimens of *Rattus* were not nearly so common at the edge of the clearing as on the plantation lower down the slopes, where human activities offered a great selection of hiding places and a greater variety of food. Our first specimen of the rare tree shrew, *Urogale everetti*, was taken in a small patch of *talbac* near the cabin. Numerous logs around the edges of the grassland and clearings were rich in invertebrates. Beside the cabin an abandoned coffee plantation and a much overgrown vege-

table garden offered a variety of invertebrates, some different from those we took elsewhere. Our impression of the 3,000-foot level is that it is very definitely an area of faunal intergradation between the upper and lower altitudes.

The variety of second growth about the plantations between 2,000 and 2,800 feet supported a fauna typical of the lowlands. We took numerous caecilians that Celestino captured as they slithered away when he lifted a large mass of decaying grass. These are the first records of caecilians from Mindanao. The only specimen previously recorded from the Philippines was taken at Palawan. The Manila hemp plantations harbor relatively few animals except some lizards and banana frogs, fruit-eating birds, especially certain pigeons, Malay civets (*Viverra*) and palm civets (*Paradoxurus*). The birds and mammals eat the small, mealy bananas that grow on the hemp, and their droppings, studded with the small, hard, black banana seeds, are numerous on the road. We were told that tarsiers (*Tarsius*) might be found in the hemp but we found none, although the decaying plants were often fertile collecting places for scavenger and predacious insects. Predacious Hymenoptera and Diptera, and frequently Homoptera, sunned themselves on the broad leaves of the plants.

As soon as we had disposed of our equipment and arranged our working space, we began cutting a trail up the ridge through grassy openings, virgin forest and second growth. Naturally, a variety of invertebrates, amphibians, and birds frequented this ecologically heterogeneous stretch. We trapped few mammals here, although we secured the one and only mountain tarsier obtained between the virgin forest and second growth. Another mammal that delighted us here was the elusive pygmy squirrel (*Nannosciurus*), which inhabits the older second growth and the original forest, and extends into the mossy forest on the few trees with little or no moss, up to at least 6,400 feet. Our specimens were the first of this genus taken from the east side of Mindanao. They could frequently be heard chirping, but they are so quick and small that we seldom got a shot at them, and, we regret to say, even more seldom could we locate the animal after it was shot.

After 3,800 feet the trail passed through virgin forest alone. Beginning at about 4,400 feet the woodland began to assume a gradually increasing mossy forest aspect until we reached 5,200 feet, where the rich moss and epiphytic growth made every outline fuzzy.

Intermediate Mountain Forest (3,800 to 4,800 Feet)

It is evident that the typical species of lowland *Dipterocarpus* disappear in the intermediate mountain forest, but because of the absence of literature pertaining to this type of forest and the fact that our botanical collections have not yet been identified I cannot report on the species composing it. Many of the trees are oak (*Quercus*). It is, however, a forest that varies locally. Tall *Pandanus*, common only at this elevation, are scattered throughout or in a few places are grouped in great stands. A few of the trees are tall, but most of them vary greatly in diameter and height. Tree ferns are common and extend up to near the summit. Heights and densities of shrubs and herbs vary in all degrees. Almost everywhere there is a good layer of humus. Moss and lichens are very frequent and become more so as altitude is gained, but this growth is not nearly so luxuriant as above. We did not camp in this forest but collected in it frequently on our numerous trips up and down from our mossy forest camps to base camp.

Mossy Forest (4,800 to 8,000 Feet)

From 4,800 feet to just below the peak there is a well-developed mossy forest. To say that it rained almost all the time during our several weeks' stay there is to state the situation quite literally. Not only the density of the moss-covered trees but the continuous clouds and haze make this forest so dark during the day that we often used our flashlights to collect and sort invertebrates, and it was necessary to light our Coleman lanterns by three o'clock in the afternoon. We maintained camps at 5,200 feet from August 18 to September 1 and from September 28 to October 2, at 6,400 feet from September 1 to 12 (see pl. 5, fig. 2), and at 7,200 feet from September 9 to 30 (see pl. 5, fig. 1).

From 4,800 up to 6,400 feet the mossy and epiphytic growth becomes increasingly heavier. Beginning at about the 6,400-foot camp and extending to 7,700 feet, the forest is considerably stunted except in well-protected valleys. One is usually climbing over or crawling under or slipping through a mass of soggy, moss-covered roots and tree trunks. Few of the trunks exceed a foot in diameter at eye level yet their mossy covering makes them appear to be from two to three feet in diameter.

At any elevation in the mossy forest few invertebrates meet the eye, but when we began to beat the trees with stout sticks, pull apart or comb the moss, or look underneath it on tree trunks and

branches, logs, rocks, or soil, the variety and quantity of small animals were amazing. Bird life is rich in these forests but the numerous tiny birds that unconcernedly flew within a few feet of us were often too close to shoot (and at this time we had no suitable weapons or ammunition for obtaining them). Some of the least known of the Philippine birds were obtained in these forests. We saw no deer here, though we heard a few in the distance, crying like excited, yelping dogs. Monkeys reached the 6,400 foot camp, but seldom in bands; usually there was only a lone old male that chattered at intruders. Small mammals were not common, but by persistent collecting we managed to get good series of *Rattus*, *Apomys*, *Bullimus*, and, best of all, the seldom collected and important insectivore *Podogymnura truei*. We saw some bats in the mossy forest but were unable to collect them. No lizards reach this elevation, but several species of frogs and toads reach the lower limits of the stunted mossy forest, where they disappear. We collected no frogs or toads near or above our 7,200-foot camp, though on some nights when the wind was not too high we heard what we thought was a single frog with a plaintive peep, a long way off. Up to the 6,400-foot camp we frequently beat frogs out of tree ferns and less commonly out of small trees. At night the frogs provided a cacophony of sounds that drove us to desperation because, try as we might, we were seldom able to track down the little noisemakers. Some of these frogs lay their eggs in moss or under bark, and tiny, four-legged, tail-less replicas of their parents emerge. A single adult was found with each batch of eggs. We found a few of these clusters and watched the embryos gradually losing their tails and developing hind legs, as tadpoles do in the water, and then finally emerging, smaller than many of the beetles we were collecting. We encountered one species of snake from 6,400 feet down to the base camp, but in the mossy and mossy stunted forest we found very few others. Those we did find were curled up in moss or wet logs.

Just below the stunted forest we chopped a tall tree and made interesting collections of invertebrates living in and on it from ground level to about a hundred feet. The collection was not as large as we had hoped, but it included a number of insects we did not take within reach of the ground. In some dry, mealy vines high up on the trunk we found some of the most showy insects of our entire Philippine collections, a large, metallic pachyrrinchine weevil and several scarab beetles and their larvae. It was interesting that we also found large earthworms in the dry vines about fifty feet above the ground. Near our 6,400-foot camp several seepage

areas in small valleys provided species that we did not take elsewhere. Of chief interest to us were the numbers of the tiny trichopterans that inhabit rock-cases, the invertebrates on and under the rocks about the seepage areas, and the rather greater concentration of invertebrates and tiny frogs in the tree ferns and small trees here as compared with the rest of the forest.

The mossy stunted forest that began near our 6,400-foot camp extended to the upper three hundred feet of the mountain. Many of the trees in it are twisted at crazy angles, the branches are gnarled, and the roots are largely above the ground. The trees seldom exceed twenty-five feet in height, and a conifer (yew?) is common among the hardwoods. The moss reaches its greatest density in this type of forest, the atmosphere is always saturated, and it was almost always so dark that it was necessary to use a Coleman lantern in camp during the day. The winds were chilling. The temperature varied between 51° and 57° F., but we often felt cold because of the saturated atmosphere and the difficulty of drying out. Working in the moss meant getting soaked from head to foot and staying wet until sleeping time.

Birds singly and in flocks were common in the forest, and we took some that we did not take below, but many of those shot could not be found in the moss or the trees and ground. Mammals were scarce but we did trap a few specimens of *Rattus*, *Apomys*, and *Podogymnura*.

In the mossy stunted forest we noted a subtle change in species of invertebrates. These changes can best be analyzed after study of the collections. There was, however, no subtlety about the change in invertebrates found on the upper three hundred feet of the mountain, where the density of the moss diminishes, the vegetation is drier, and the trees are straighter and as tall as those around 4,000 feet.

The trees on the almost flat summit ridge are rather openly spaced and not nearly so mossy as those below. Apparently because of the northeast to southwest direction of the ridge, it is more protected from the heavy winds that hit the slopes just below it, and for the same reason it receives less rainfall. We found a considerable drop in numbers of species, and some differences from those below, among the invertebrates we collected on the summit. Few birds and no mammals were taken there, though berry-like mammal droppings, which we did not encounter elsewhere, were common on the ground.

We were so busily engaged in the work of collecting and preserving the specimens from the magnificent fauna of these drenched slopes that we made only brief excursions into the drier interior slopes of the mountain, a fact which we now regret, for our small collections of invertebrates from these slopes are entirely different from those on the exposed slopes. The forest on the dry slope is without moss, very well drained, and exceedingly dense and entangled with shrubs, rattan, and climbing *Pandanus*.

MOUNT APO[1]

Sea Level to Todaya (2,800 Feet)

After terminating our work on Mount McKinley we spent a couple of weeks in packing specimens, sorting equipment, and warming up and drying out by collecting in the lowlands of Tagum Municipality, at the north end of Davao Gulf. Then, on October 16, Heyneman and Alcasid left to investigate the road and general situation at the base of Mount Apo. Alcasid remained to get a lean-to built for base operations at the Bogobo village of Todaya and to secure guides and carriers. Heyneman returned after a few days with his report. On October 22 Werner started up to the base camp with the second group, consisting of Edaño, Convocar, and Añonuevo. Heyneman, Celestino, and I remained at Davao City to complete shipping arrangements, make last minute purchases, and collect in the Luangbay Cave. On October 25 we started for Mount Apo (see fig. 4). Castro, who had been left at Madaum to obtain additional series, arrived at Todaya about November 4.

Mount Apo, an active solfataric volcano, is the highest peak in the Philippines, 9,690 feet above sea level. For our ascent we chose the route via Sibulan (at about 1,000 feet elevation) because of its proximity to Davao City and because we could drive to Sibulan, though with difficulty, in our truck. From Sibulan to Todaya, the slippery, steep trails are tiring.

The population of Sibulan is a mixture of peoples, mostly Bogobos, who operate small hemp stands near-by. A few of the Bogobos from Sibulan may venture into the lowlands a few times during their lives, but those who live higher on Mount Apo state that none of them ever go below the town. Sibulan is reached by turning west (right) off the Davao-Cotabato highway at the 27.5 kilometer mark and going inland eight kilometers through a Spanish cattle range, through the village of Baracatan, and thus up to Sibulan. Werner

[1] From notes of Harry Hoogstraal and Donald Heyneman.

made small collections of insects on two occasions when he passed through Sibulan.

On October 26 our party and eleven Bogobo carriers started off from Sibulan, crossed and recrossed the raging Sibulan River, and reached our makeshift shelter at Todaya in the early afternoon.

Much has been written about the fierceness of the Bogobos, their custom of wearing certain colors of headbands to indicate the number of people they had killed, and their belief that the more human livers they ate the stronger and braver in battle they were. Anthropologists and early American occupation troops vouch for these facts, but since the middle 1920's the Bogobos have been converted to Christianity and they now practice with consistency and unaffected willingness the Christian precepts of generosity, kindliness, helpfulness, and strict honesty. Their clothes, highly decorated with beads and shell disks, are still woven from Manila hemp and dyed from local juices; their women still jingle-jangle with innumerable little bells as they walk or work; and the same unique, beaded betel-nut bags, betel-nut knives and bush knives accompany the men wherever they go; but the long spears they carried in former times are now only infrequently seen, and a stout staff forms the substitute. Isolated as they are, the Bogobos are the happiest and best provided for of any of the peoples we saw in the Philippines. They exchange hemp for the outside goods they require, such as salt, fish, tobacco and Chinese beads (and the luxury of matches). Their fertile fields supply them with more than enough corn, upland rice, cooking bananas, and *camotes*, and when they desire meat they can kill a chicken or spear a deer or a wild pig.

Their houses are constructed of bamboo, which grows in enormous stands on the Todaya plateau. The bamboo is held together with the rattan vines that grow in the forest, and the shingles are made from cut sections of the bamboo stems.

We were particularly interested in Todaya because it is considered one of the most important type localities for mammals in the Philippines, as a result of Major Mearns' visit there early in the century. We were fortunate in securing series of his unique genera and species. While the majority of our group was stationed higher up on Mount Apo, the Todaya camp was maintained by two or three of our Filipino members who did some shooting and trapping. Certain of the Bogobos were assiduous collectors and brought to the Todaya camp, among other things, an excellent series of larval

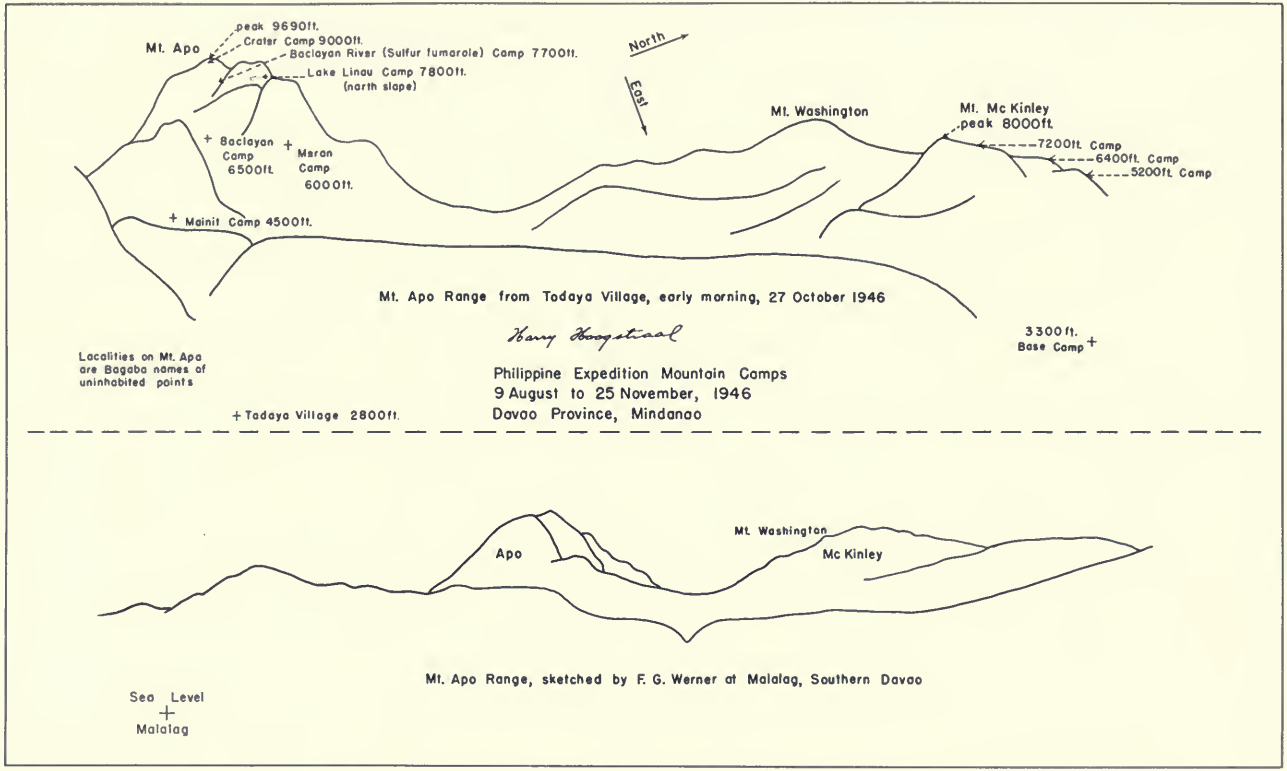

FIG. 4. Profiles of Mount Apo Range, southeastern Mindanao.

caecilians from the Sibulan River and many tree shrews, *Urogale everetti*.

Todaya (2,800 Feet) to Lake Linau (7,800 Feet)[1]

Throughout our stay in Mindanao we had heard of a fantastic lake on the side of Mount Apo. This lake, which had been much visited by Japanese biologists during the Japanese occupation, was reputed to have a unique fauna, besides being the haunt of large pelicans. The lake was discovered by American officers in 1928 and later visited by Hachisuka, the Japanese ornithologist-explorer. He reports the name as Faggamb, but since we could not elicit any name except "Linau" (a name common in many Filipino dialects for "lake") from the Bogobos, we prefer the name Lake Linau on our labels. We found no pelicans or unique aquatic fauna at Lake Linau, but there was enough of interest to repay us for our efforts in getting there. We made the trip in a day and a half from Todaya.

Our group circumvented the climb up the terribly steep slope above the Todaya plateau by going off at a gradually climbing angle and coming back again. Then we did some rather strenuous up and down climbing, through streams and across forested ridges until we reached a rolling plateau with beautiful, tall, rather close-set trees and little undergrowth. At the far end of this plateau we crossed the Mainit River and, beyond it, experienced steeper going up the Baclayan River bed, which was dry at the time. By three o'clock in the afternoon we had reached Baclayan (elevation 6,500 feet). The climb that day had been up the east slope. There was some moss on the ground and on the trees up to this elevation, but only a fraction of that found at the same altitude on the near-by east slope of Mount McKinley. Below Mainit, at 4,300 feet, there was almost no moss. Early the next morning, Tuesday, October 29, we started out. That day's march was gradually from east to north, up and down ridges, some of them rather precipitous. As we approached the north slope the moss and epiphytes became increasingly more dense. About two o'clock a vacant space showed from a ridge top, and then the wondrously beautiful vista of Lake Linau came into view.

During our ten-day stay at the lake, which is at 7,800 feet altitude, the temperature varied between 50° F. at night and 60° during the day, though on four days it rose briefly at mid-day to 64°. Sun

[1] All place names in the following paragraphs are Bogobo place names for uninhabited hunting spots.

shone through the haze for less than fifteen hours during this time; it drizzled at least three-fourths of the time, and rained considerably. On the last three days of our stay, heavy rains and cold, strong winds made the spot a bit difficult.

The lake is about a quarter of a mile long (from east to west) and almost as wide, although obviously the size varies with the rainfall. At the time of our visit we estimated that the dimensions were about three-fourths of the maximum. In some places an eighty-foot dropline failed to touch bottom. The water is deeply colored, greenish-blue. It receives some drainage from the hills around it, but only small trickles of streams flow into it. Tall grass and reeds grow out into the water, and the edges, where they are not flat, are mossy (see pl. 7, fig. 1). We took no aquatic birds, mammals, fishes, or distinctive crustaceans at the lake, but many insects were taken on the surface, where they had been deposited by winds, and a single caddis fly larva was found in the moss at the edge. Two species of dragonfly nymphs, two species of dytiscids, several small species of hydrophilids, chironomid larvae, and notonectid bugs (but no water striders) comprised the aquatic insect fauna of the lake, in addition to mosquitoes. Among the reeds and grass at the edge, a number of larval specimens of an apparently new species of *Culex* (*Culex*) were taken, as well as others that cannot be differentiated from *Anopheles lindesayi benguetensis*. These larvae were reared to adults, and the larval and pupal exuviae associated with the individual adults, the system used for several thousand mosquito specimens on the expedition. Some mosquitoes, apparently the same species, were found in a seepage pool beside a rock near the lake.

We spent many hours pulling up the moss at the edge of the lake, tearing it apart, and floating it on the surface. A fine variety of invertebrates kicked themselves out when so treated, among them many carabids of several species, staphylinids, especially *Stenus*, spiders, cockroaches, phalangids, amphipods, isopods, and myriopods.

The lake is set in a bowl-shaped depression, the sides of which are covered with grass (where the trees have been cut), slightly open mossy forest (open for the same reason), and dense mossy forest (see pl. 7, fig. 2). At the west end is a bog, which Werner visited on the raft we made. The bog is of about the same size as the lake. At its west end, a stream, which is the headwaters of a large river, emerges and, dropping down the steep mountainside, flows into Cotabato. The bowl-shaped ridges around the lake and

the absence of a characteristic aquatic fauna in it, suggest that it may be a recent volcanic crater.

The stems and leaves of the grasses in the open forest and at the edge of the lake contributed only a few distinct specimens to our collections. The open mossy forest, so far as we can now ascertain, had much the same fauna as that of our 6,400-foot camp on Mount McKinley. The dense mossy forest, however, yielded an appreciable number of invertebrate forms that were new to the collection. By taking advantage of the short and intermittent periods of sunlight, we collected many fine insects in flight. The moss here was particularly rich in invertebrates.

Of mammals, we took only a few small rats (*Rattus* and *Apomys*) and insectivores (*Podogymnura truei*). We saw and heard a few small bats but were unable to obtain specimens of them. We were frequently awakened by deer calling within a couple of hundred feet of our camp, and there was some evidence of pigs, but we did not secure specimens of these. The same mossy forest species of birds as those on Mount McKinley were present here. A few additional species, probably attracted by the water, were taken along the edge of the lake. These were the migratory gray wagtail, *Motacilla cinerea*, and a single snipe, *Gallinago megala*, both migrants from northern Asia. We took no amphibians or reptiles of any kind during our stay at Lake Linau, though frogs and toads were common and there were a few snakes in similar forest types (but not at equivalent altitudes) on Mount McKinley. One frog with eggs was taken under the bark of a log in a non-mossy, open spot at 6,800 feet, eleven hundred feet below the lake, on the northeast slope of the mountain.

We collected at least fifty species each of orchids, ferns, and mosses within the immediate vicinity of the lake. The trees in the forest are not as tall as those in the mossy stunted forest of Mount McKinley. Trees continue up the north slope to the peak of Mount Apo, according to Hachisuka, but on that slope we did not climb more than five hundred feet above the lake. On the mountainside, above the lake, the trees become noticeably smaller and more windswept, and at the top of the ridge all we could see was tall grass; it is possible that trees persist in sheltered valleys that were hidden from us by the mists.

The Bogobos insisted that it would be impossible to carry the loads up the north slope to the peak, and on November 3 we began sending equipment down to Meran, on the east slope.

Meran Camp (6,000 Feet)

The Meran camp was maintained from November 3 to 10. We had decided to collect at this spot when we passed it on the way to Lake Linau because of the grassy streams and the open forest. It was apparent that over a long period of time a few Bogobos had lived there and had cut trees here and there in the forest. We collected in both the undisturbed and the cut-over forest, and, as is so often the case, the cut-over forest was richer, at least in varieties of invertebrates. Oaks were scarce. In the cut-over forest there were areas both of little and of much undergrowth. The few large trees had smooth bark and lacked buttresses. There were many trees of six inches to two feet in diameter spaced about twenty feet apart. Frogs were obtained from the stream and by beating trees. Deer and pig were shot near-by, *Apomys*, *Rattus*, and about a dozen *Podogymnura* were trapped, and pygmy squirrels, *Nannosciurus*, were seen and heard. Most gratifying of all, the rarest of Philippine birds, *Malacocincla* (*Leonardina*) *woodi*, known only from the type specimen and much sought by other collectors, was obtained.

The minimum temperature was 56° F. and the maximum 66° F. We had light rains in the late afternoon and evening each day of our stay.

Baclayan Camp (6,500 Feet)

Our Baclayan camp (6,500 feet) and Baclayan River (sulfur fumarole) camp (7,700 feet) should not be confused because of the close similarity of locality names. Unfortunately the possibility that these locality names might cause difficulty did not occur to us when we were in the field.

We camped beside the dry, white sand bed of the Baclayan River, at a hunting spot known to the Bogobos as Baclayan. The camp was maintained from November 9 to 17. We visited it only for three days, but part of the Filipino group, who suffered badly from the cold at higher elevations, remained here while we worked near-by and at the peak of Mount Apo.

The forest at Baclayan camp was what we term a ravine type, with the trees close and of varying heights and diameters, and with dense undergrowth. There is almost no moss, but the humus layer is thick and moist. Along the dry river-bed a species of conifer and another of a thick-leaved shrub are common. During the one day we recorded the temperature, it ranged from 53° F. at night to 60° F. during the day.

Baclayan River (Sulfur Fumarole) Camp (7,700 Feet)

On November 12 we left Baclayan and after about three and one-half hours of steady climbing, we reached our Baclayan River camp. The camp was located just below the point where tree and shrub vegetation disappears on this slope. The hissing of the great sulfur fumarole, about three hundred feet above us, could be heard at almost all times.

The route to this point traverses a variety of forests in which large trees and shrubs and herbs needing moisture are found only in ravines and valleys. Where not so protected the forest becomes gradually lower and more scrubby and drier in appearance. On the ridge, from about 7,200 to 7,900 feet, the trees are not over twenty-five feet in height and are usually lower. They are scattered on the slopes but are dense in the small, protected areas. Grassy spots are common, and some dozen or so species of blooming herbs grow in the rock crevices or grass. The leaves of the shrubs and shrub-like trees are thick, and there is no humus. Ferns of the xeric type are common. Near the camp we found pitcher plant (*Nepenthes*) with *Tripteroides* mosquito larvae in the pitchers. This was the only place in the mountains where we found pitcher plants from two to eight feet above the ground. A few trees in the dry forest on the slope about eight hundred feet below camp contained dense vines of a different species of pitcher plants, growing from twelve to twenty feet above the ground. These also had *Tripteroides* larvae in their pitchers, as well as an interesting variety of other insects. The pitcher plants in the wetter forest were all very high up in trees. (The vines of pitcher plants in dry grasslands elsewhere in Mindanao lowlands and in Luzon highlands trail over the ground.)

The invertebrates in this dry, stunted forest were not especially varied in species but were numerous in individuals, and, so far as we can tell, are entirely different from those we took elsewhere (except for one pentatomid and one weevil we took on the summit of Mount McKinley). A few *Apomys* and *Rattus* were taken in the forest, in addition to one as yet unidentified small rodent.

Baclayan River Camp to Peak (9,690 Feet)[1]

The trip from the Baclayan River camp to the lower level of the crater ridge takes about four hours of steady, hard climbing. The climb from the crater lake to the peak point takes another hour.

[1] Of the three large peaks of Mount Apo, the southwestern one is the highest and is the one referred to in this paper.

Progress is best up the dry bed of the Baclayan River past many sulfur fumaroles, steam-heated caves, and chunks of yellow sulfur. The large andesite blocks in the river-bed are not too difficult to scramble over or between, but are sometimes insecure. After we burned our hands on little fumaroles we learned to watch where we leaned for support.

At the head of the deep gorge we came to a ridge some five hundred or more feet high, running at right angles (north and south) to the gorge. The headwaters of the Baclayan River are at the base of this ridge. Here we crossed fields of tremendous boulders (see pl. 6, fig. 2), with huckleberry bushes sometimes widely scattered, sometimes in dense stands. Bracken ferns were also scattered, but just below the crater on one slope they were as tall as we were, and impenetrable. Light growths of thin mosses and a very few herbaceous plants were found in a few protected places in the boulder field.

We entered the crater at the east end, where the wall is only a few feet high. A shallow lake, less than three feet deep, covers the flat bottom. If the water were to rise just a few more feet it would spill over the low east wall, but there is little evidence that it does this. The scanty grass is kept cropped close by deer, whose paths are heavily worn. Low shrubs are scattered about the walls.

I tried to make a complete collection of insects in the crater, but they were rare indeed on vegetation and under stones. On the second day of our stay, I noticed groups of swiftlets coming in, flying low and apparently feeding and then flying off. They repeated these flights each ten minutes or so, and after a few such visits, I left the sides of the crater and went down to the lake to see what was attracting them. I found the surface of the water literally covered with insects, among them beetles, flies, wasps, bees, stink bugs and other Hemiptera. Just then a gust of wind came over the west wall of the crater, and hundreds of insects were deposited on the surface of the lake. I spent the rest of the morning and early afternoon collecting these insects, which are among the most remarkable of those taken on the expedition. Among some two thousand specimens of thrips Dr. L. J. Stannard has found numerous species. In two vials with over four hundred chermids (tiny homopterous insects looking like miniature cicadas), over half a dozen species are represented. From field comparison of this collection with others, it is evident that many of the specimens come from high altitudes.

During our stay in the crater, the temperature varied from a low of 46° F. at night to 59° during the day. While I was specializing

on the crater fauna, Werner and Heyneman climbed the crater ridge, which requires about an hour, and tried to pick the highest point from among several of almost equal height. The grass at the peak is also kept closely cropped by deer. In some small marshy depressions they found a few dytiscid aquatic beetles and some ground beetles (*Bembidion*). They also saw a continuously singing pair of starling-like birds with circling flight, and some thrushes and sunbirds. Deer were abundant, but in three nights our one hundred traps took no smaller mammals, and we saw no signs of any.

Mainit Camp (4,300 Feet)

From the peak we went down to the Mainit camp (after a one-day stopover to break camp at Baclayan), which had been established on the Mainit River a few days earlier. The forest around Mainit is of a peculiar type, and palms, vines, ferns, shrubs and herbs, many of them spectacular and immense, are common (see pl. 6, fig. 1). Invertebrates and frogs are numerous.

Lowlands of Davao Province

MADAUM AND VICINITY, TAGUM MUNICIPALITY[1]

A Manila hemp plantation, owned and operated by the International Harvester Company, is located at Madaum at the northern end of Davao Gulf. Werner, Castro, Alcasid, and Edaño were stationed at this plantation from October 8 to 20, and Castro remained until November 3, 1946, returning for additional specimens between November 20 and 31. Rodents were scarce here, but reptiles, especially pythons, cobras, and pit-vipers, and several species of the burrowing snake, *Typhlops*, were collected in surprising numbers. Aquatic birds of various kinds and shore birds were secured from the mangrove and narrow beach areas bordering the Hijo River and Davao Gulf. Insect collecting in this area was poor.

The Madaum area is flat and largely cultivated. Manila hemp stands are extensive and there are many coconut groves, corn fields, and vegetable gardens. Second growth, old and new, of many types, is interspersed among the cultivated areas, and clearing operations in these provided numerous specimens. There are extensive weedy marshy areas along the near-by Hijo River, and some mangrove areas and small sand beaches along the Gulf.

[1] From notes of Harry Hoogstraal and Floyd G. Werner.

Almost all the herpetological species and most of the mammal species except rodents and insectivores known from the Davao Gulf lowlands are represented in the Madaum collections, in addition to several species not heretofore recorded from the area.

During his stay in Madaum, Castro obtained specimens from the near-by *barrios* of Busaon, Libuganon, and Magupo, and on the trip from Davao City to Madaum he shot a number of bats at the second ferry at Tuganay, near Madaum. At dusk one can see thousands of these fruit bats flying from fifty to two hundred feet above the ground, not close together, in a southwesterly direction. We were told that they feed near Davao Gulf.

MACO AND SITIO TAGLAWIG, TAGUM MUNICIPALITY

The trip to Maco was made chiefly for the purpose of collecting animals from the trees that were being felled for lumber there. Few trees were cut during our stay, but they supplied a magnificent variety of insects, many of them spectacular, which we did not find elsewhere. Large Homoptera and, of course, Orthoptera, the variety of which reaches fantastic proportions in the Philippine forest, can be particularly well taken under these circumstances. The crashing of branches from newly felled trees disclosed a number of subcortical insects that leave the trees soon afterward because the wood rots rapidly.

Our party, composed of Heyneman, Celestino, Añonuevo, and myself, remained at Maco and Sitio Taglawig from October 9 to 19, 1946. Heyneman left about a week early to make initial preparations for working Mount Apo. Maco, which is just east of the Hijo River, can be reached only by boat from Davao City or Madaum, or by walking from Madaum. A canoe must be used to cross the river. We maintained a base camp at Maco and a subcamp at Sitio Taglawig, some twenty kilometers inland from Maco, at the edge of the original forest. The forest covers almost flat and low hilly country, with many small streams flowing through little ravines. The trees are tall and straight, forming a dense overhead canopy, under which there are smaller trees. Herbs and shrubs are scant except on hillsides or in ravines, where the tangle is often thick. Almost any place where the ground is not steep one can walk with little interference from ground vegetation and vines. The forest is relatively cool, and has a good layer of humus. Frogs and lizards are common in it, but snakes not nearly so apparent as in second growth. We were disappointed in finding no arboreal

forms of vertebrates from trees that were being felled. Squirrels are not rare, but are considerably more difficult to see than in the Palawan second growth. Bird life is abundant, but much of it is high among the crowns of the trees. Rodents are scarce, except at the edge of the forest where several specimens of the *everetti* and *Bullimus* groups of rats were obtained.

In a coconut grove near Maco, a number of flying lemurs were found feeding in mango trees, and marsh birds were common along the coast and near the Hijo River. The swampy country around Maco was rich in insects, which were attracted to lights at night.

SAMAL AND TALIKUD ISLANDS, IN DAVAO GULF[1]

Samal, a low island in Davao Gulf just opposite Davao City, is easily reached by the numerous outrigger canoes that wait for passengers on the beach just off the road running north from Davao City. We were interested in the island because of stories of its caves, which were reputed to harbor many bats, strange insects, eels, and fish. Celestino and Heyneman visited Samal between December 2 and 5 and explored its two caves. The first, Tawang Cave, near the village of Quinawitnan, is in the eastern part of the island, about a hundred yards from the beach and fifty yards from a planter's house. The cave is in wet limestone and the main branch extends about an eighth of a mile underground. The main entrance, a nearly circular cave-in about fifty feet across, drops into a main tubular horizontal shaft. Two vertical entrances near-by open from the slope above the beach. Three species of bats and a few invertebrates were taken from the cave, but there were no distinctive cave animals among them.

The second cave, in the center of the island near the village of Peñaplata, was flooded and filled with mud, so that we could not enter. Shrimps were collected in the pools at the entrance. In the hope of collecting in other caves, the near-by island of Talikud was visited, but all the caves were sealed, and only some pre-Spanish human bones and very old pottery, which we deposited in the Philippine Museum, rewarded the effort.

MATI MUNICIPALITY

Mati is the type locality of the largest described species of Mindanao deer, and Convocar was sent there on December 23, 1946, to secure topotypic deer and other specimens. Mati can be

[1] From notes of Donald Heyneman.

reached only by water, though a small air-field is now in preparation. Convocar returned on January 14, 1947, with small collections from the area around the town of Mati, as well as from Kamansi and Mayo, on the short roads extending north and south out of Mati. We have been unable to secure information about this area, and about the location of Parombon, the fourth of Convocar's localities.

LACARON, MALITA MUNICIPALITY[1]

Flying lemurs (*Cynocephalus volans*) are especially common in the coconut groves at Lacaron, and Werner and Castro took the boat to that locality, with eminently successful results. They started the trip on February 3 and returned on February 10, 1947. Lacaron is a small village devoted to copra manufacture. The town lies in a wide stretch of coastal plain. The members of the party were received very hospitably by Mr. Patstone, a Spanish-American War veteran, and his family, who housed and fed them. A few miles south of Lacaron a number of specimens of bats of the genera *Pteropus* and *Acerodon* were secured from separate colonies in a mangrove area. A white-breasted sea eagle (*Haliaeëtus leucogaster*), which nested in a tall lone tree near-by, is said to prey on the bats. Flying lizards (*Draco* sp.) were common in the coconut groves, and several crocodiles were taken along the edge of the beach.

SOUTHERN MALITA MUNICIPALITY

We had not intended to collect specimens in this municipality, but Celestino and Oañe, bound as an advance contingent for Caburan with collecting and preserving supplies, misunderstood their instructions and disembarked at the coconut plantation at Lawa. Celestino was injured while landing in the surf, and remained in this area until picked up on the return trip from Caburan. Oañe joined us at Caburan in the middle of January. Celestino, who is an excellent collector, could not go far afield because of his injury, and so his collections were confined chiefly to such vertebrates as he could buy or trade, and to insects that he found around Coleman lanterns.

There is considerable second growth in the Calian area, bordering the extensive coconut plantation, and tarsiers are abundant in it. During a part of their stay at Calian, Celestino and Oañe maintained a camp at Lapuan, on a forested hill just behind the Calian plantation, and also worked the near-by *barrio* of Taytay. The collection of insects from Calian contains a number of species that we did not

[1] From notes of Floyd G. Werner.

take elsewhere. The vertebrate specimens are much the same as those in the other Davao Gulf lowland collections, except that Calian is the only location where the pretty pygmy falcon, *Microhierax erythrogonys*, was taken.

From time to time specimens were taken near Digos, in southern Malita Municipality. It is at Digos that one turns west on the highway across the middle of Mindanao.

MALALAG, SANTA CRUZ MUNICIPALITY[1]

Werner and Celestino, accompanied by Mr. Pilar, of Davao City, who was acquainted with the tarsier population at Malalag, made a short trip (November 27 to 29, 1946) solely for tarsiers.

Malalag is reached by road from Davao City, though the last portion of the trip is very rough and is sometimes impassable. Quarters were in an abandoned copra shed at the end of the road, on the seashore. A narrow mangrove area, bordered inland by low hills, runs along the coast. Bamboo thickets at the edge of the second growth were searched for tarsiers. This is as far north on the Davao Gulf coastline as we found the large, noisy gecko (*Gekko gecko*) in any abundance.

CABURAN MUNICIPALITY

Caburan Municipality is an isolated area on the west coast of Davao Gulf inhabited chiefly by the Monobo (also called Manobo and Kaburan) and Bila-an tribes. The trip to Caburan was planned after persistent reports over a five-month period had indicated that this was the likeliest place to find the monkey-eating eagle and the tarsier. On January 6, 1947, Celestino and Oañe started to Caburan, but they misunderstood the directions and disembarked at Calian with most of the equipment. On January 8 I went to Caburan, accompanied by Mr. C. H. Wharton, a commercial live-animal collector who had just come down from Manila. Later in the month, Oañe joined me, but Celestino, because of an injury he had received when landing in the surf, was forced to remain at Calian and we picked him up on the return trip to Davao City on January 30. Wharton returned to Davao City after about a week, by which time his purchases had brought in so many tarsiers and other animals that he could not handle more. Oañe and Añonuevo returned to Caburan between February 12 and 21, 1947, to investigate a supposed monkey-eating eagle nest, and returned with a few other specimens.

[1] From notes of Floyd G. Werner.

The low mountains that border the narrow coastal plain and extend inland to the vast central Mindanao lowlands are virtually unknown. Foothills come down to the sea throughout most of this area, but the narrow, flat, coastal plains, wherever they occur, are devoted to coconut plantations or are overgrown by a dense second growth of small trees, particularly just behind the beach, or by a ten- to twenty-year-old second growth of taller trees with herbs or shrubs among them. There are numerous patches of much disturbed remnants of original forest and also many small streams. Except for some small clearings, the foothills away from the coast are still covered with original dipterocarpous forest, though these will probably soon be cut over for the excellent timber in them.

Our activities in this area were chiefly in the second growth, because this type of vegetation was so productive of specimens. Superficially, the second-growth facies is drab, but upon examination it appears that the clearing and regrowth, accomplished over a period of some thirty to forty years, have produced enough varying situations to support a great quantity and quality of animal life. Here as elsewhere, overgrown and more or less abandoned coconut groves are rich in animal life. The forest streams, grassy areas, narrow ravines, old second growth, and burned clearings have a variety of inhabitants. Disturbed original forest with its many logs, small cleared areas, and alternating dark and sunlit patches is especially good for invertebrate collecting. Collecting for frogs, lizards, birds, and many kinds of invertebrates is good in the original dipterocarpous forest, and the species are generally different from those outside, but a considerable part of this fauna occurs high in the trees and is ordinarily unobtainable.

The number of rodents in the areas of second growth here and elsewhere in southeastern Mindanao is far from large, possibly in part because of the number and variety of snakes that flourish in this type of growth. For some reason, both the Malay civet (*Viverra*) and the palm civet (*Paradoxurus*) appeared to be rare in the Caburan area. The tarsier, however, reached unsuspected numbers in the second growth (see pl. 3, fig. 1). No monkeys were seen outside of the original forest, but there they were abundant and supported a population of monkey-eating eagles, each pair of which apparently flies over an area about twenty miles in length. Small caves in the rocks at several places up and down the coast near Caburan harbored several species of small bats.

The municipal seat, Caburan village, consists of a few houses on a low hill half a mile from the ocean. Four miles south of Caburan,

there is a small hamlet called Malabutuan (also known as Marabutuan), and about four miles north of Caburan there is another settlement, called Culaman. Culaman can be reached either by walking along the coast or by a pleasant walk over low hills and through ravines about a mile inland. Our Caburan Municipality collections come from these three localities and from three low mountains just south of Caburan village, Mount Tacob, Mount Busaw, and Mount Batuan.

Cotabato Province

NORTHERN COTABATO PROVINCE[1]

This trip (see fig. 5) began on December 1, 1946, and ended on January 11, 1947, the party consisting of Werner, Alcasid, Edaño, and Añonuevo. In August of 1946, a few collections had been made in Parang, Cotabato, when the boat on which the expedition was traveling to Mindanao stopped to unload part of the supplies.

The party left Davao City in the expedition's jeep and three-quarter-ton truck, and was able to reach Malasila, Kidapawan, the first night. The road was muddy and rough and there were delays at fords where bridges had been blown up during the war. Malasila, at about 1,300 feet altitude, is on the lower western slope leading up to Mount Apo. The surrounding country is a fairly damp farming area, with some *abaca* and *camote* plantings fringed by much the same type of second-growth forest as we had encountered on Mount McKinley in Davao. On the second day, the party drove down into the central marsh area of Cotabato but because of rain could only reach Midsayap, a distance of eighty kilometers. The Midsayap area is marshy and under extensive rice cultivation. The third day dawned clear and the party reached its destination, Parang, on the west coast. After some discussion it was decided to establish the base a few miles north of Parang on a coconut plantation at Bugasan, as it was close to a market region where guides could be secured and the population advised of the desire for specimens. Dr. Soriano, the director of the plantation, welcomed Werner and his party and provided them with quarters and working space. The region appeared to be a good collecting area, but the results obtained were so disappointing because of dryness that the party moved on. The area as far north as Malabang was tried, with the same disappointing results.

[1] From notes of Floyd G. Werner.

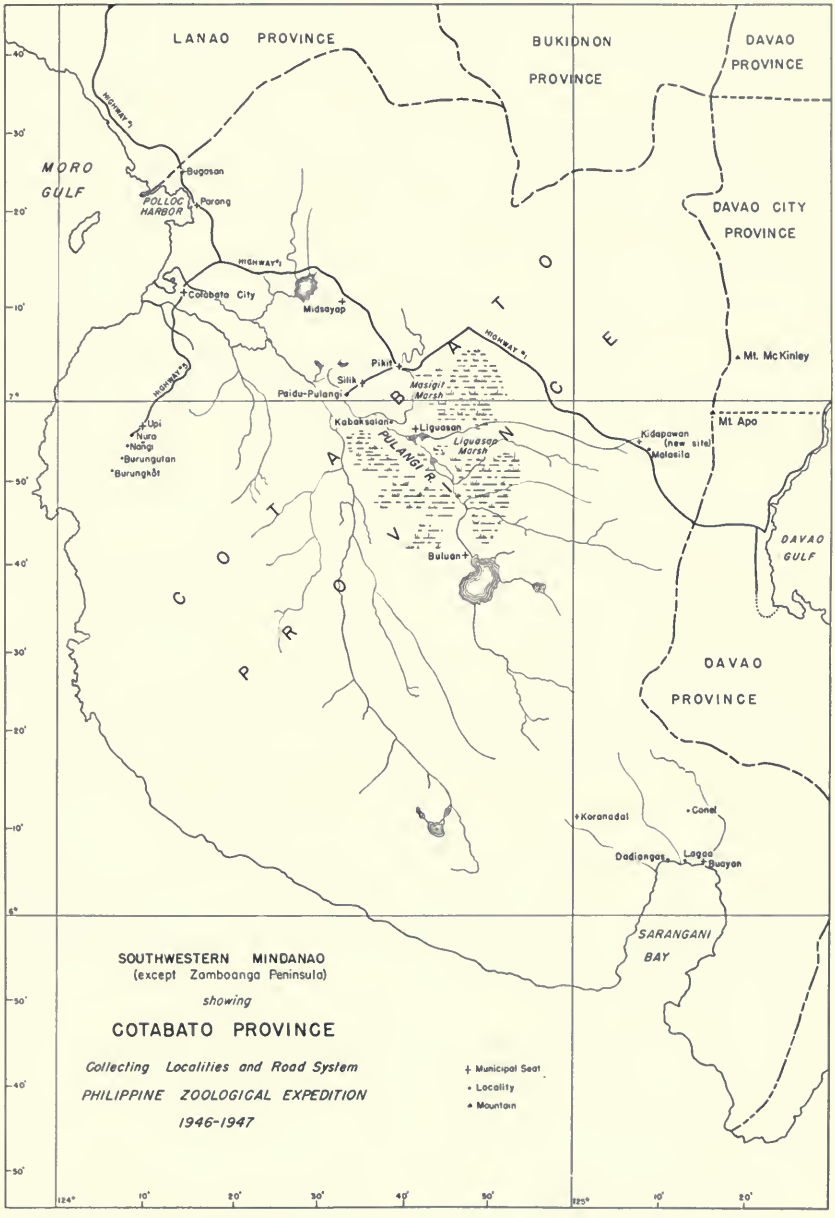

FIG. 5. Southwestern Mindanao, Cotabato Province, showing localities reached by the expedition.

On December 13 the members of the party returned to Parang, and on the fourteenth they drove to Pikit, where they shot birds in the Masigit Marsh.

On December 17, they moved to Paidu-Pulangi on the banks of the Pulangi River. The next day they arrived at Kabaksalan, and after collecting in the marsh near the *barrio*, they set out in a thirty-foot dugout, together with supplies and food, for Buluan.

The trip through the Liguasan Marsh to Buluan took three days, though the return trip was made in a single day. During this time land was met with only once. The rest of the time the boat pushed through great mats or floating islands of vegetation and through channels from four to seven feet deep. The channels were full of *Utricularia*, almost pure stands of it covering the shallower portion, and the edges of the islands were covered with masses of pink lotus, white water lilies and a vine similar to that of the sweet potato. A three-foot grass was the principal component of the huge mats.

In the past this area has been known to "sportsmen" as a virtual paradise, and the birds were so abundant that it was hard to fire a shot in any direction without hitting one of them. Three species of ducks were present, one, the "wandering tree duck," *Dendrocygna arcuata*, in enormous numbers. The party scared up flocks of them all day long. The teal, *Anas querquedula*, was only slightly less abundant. The third, *Aythya fuligula*, called "papago," was scarcest, being found only in a few ponds, and it was much warier than the rest. These three ducks were the only ones known to the Moros. Large numbers of other water birds were also present. Pheasant-tailed and comb-crested jaçanas walked over the matted bladderwort and water lilies, along with occasional moorhens and gallinules. These latter were more often found deeper in the floating islands, among the raised leaves of lotuses and in the grass. There were also several species of rails, bitterns, and herons but these were particularly difficult to obtain because the noise scared them farther into the swamp. Search for the pelicans that allegedly nested in the trees near Buluan proved fruitless, but the reports were so consistent that it is quite possible that pelicans do stay there at least part of the year. Occasional "Indian darters" or snake birds (*Anhinga*) and the buzzards (*Haliastur indus*), wheeling overhead to watch for choice morsels, completed the bird picture. Small passerines seemed absent except for the "maya-maya" rice bird, which roosted in trees along the river at night and presumably fed in the fields of rice.

Several crocodiles were brought in by Moros, who hunted them at night with lights. Before the war the marsh was a rich source of crocodile hides, which were exported to the United States, but since the war the buyers have not reappeared. One group attempted to trap small mammals on the edges of the floating islands, with no success. None of the traps was ever sprung. Insects were abundant but not greatly varied.

After leaving Liguasan Marsh, the party drove to Cotabato City. Here a fair collection was made, including bats from the Central Cave in the side of the limestone knob on which the Cotabato Military Police Command is stationed. On one of the bats, Werner collected an aberrant larva-like batfly, *Ascodipteron*, one of the prize insects of the trip.

On inquiring about likely collecting grounds, Werner learned that Upi, at the end of the road leading south, had some original forest and was generally regarded as the best hunting ground in the region. On December 31 the party departed by truck for Upi. The road twists and climbs almost all the way, finally topping a last rise and dropping into the fertile Upi Valley. Almost the whole valley has been cleared and has grown up in grass. The town of Upi, at 1,500 feet elevation, is a very pleasant place, with groves of fruit trees planted by the Upi agricultural school. An Episcopalian mission is maintained, and the whole area is considerably more progressive than the rest of Cotabato, with the exception of Koronadal Valley.

At Upi, where the road ends, the gear was placed on a carabao sled and the group walked for two days through the villages of Nuro, Nañgi, and Burungutan to Burungkôt, where they entered the forest. After having crossed hot grassland for hours they were agreeably surprised to find the forest cool and moist despite the dry season. Many of the original trees have been left and most of the area serves as a source for construction wood.

The party pitched the tent at Burungkôt on the trail south, to keep in contact with the Tirurai and let them know that specimens were wanted. Pygmy squirrels (*Nannosciurus*) were abundant, and squirrels (*Sciurus*) at least frequent. Forest birds were present in fair numbers and a good sample of the Philippine trogon (*Harpactes ardens*) was secured. Wild pigs were numerous, and the tarsier, known to the Tirurai as *matudin*, was said to be common in the bamboo clumps in the grassland. However, our people were unable to locate any, and the Tirurai, who regard tarsiers as deadly poison-

ous, refused to collect them. Insect collecting was good, particularly around several felled trees.

The party stayed at Burungkôt until the eleventh of January, and then began the long trek back to Davao. One day was spent visiting the Capilit Cave in the hills, several hours' walk from the town of Upi, and at least two bats new to our Cotabato collections were taken.

On January 15 the party arrived at Davao City, and at about the same time the other scattered field parties began to come in. Except for the short trip to Lacaron for flying lemurs, our Mindanao operations drew to a close, and we spent the next three weeks packing and regrouping for the Palawan field trip.

SOUTHERN COTABATO PROVINCE (BUAYAN MUNICIPALITY)

Our activities along the southern coast of Mindanao were confined to Buayan Municipality, on the plains and low hills bordering Sarangani Bay. The wondrously fertile grassy lowlands are the site of a large resettlement and agricultural experiment station, known as the Koronadal project, which promises a great future for southern Mindanao. A sizable population of Christian Filipinos, many of them highly trained technical personnel, lives in the project. To the east and to the west the gentle rolling grasslands are bordered by the high mountains along the coasts, and to the north stands lone and majestic Mount Matutun, almost as perfect a volcanic cone as Mount Mayon of southern Luzon. What animal life this isolated mountain harbors can only be conjectured—it may well have subspecific forms related to those of Mount Apo to the northeast of it.

On December 5, 1946, Castro and I flew to Buayan, and we collected there for the next few days in the vicinity of Dadiangas, Lagao, and in the Koronadal settlement area. On December 9 we drove north to the end of the road, where the grasslands meet a tongue of forest (much modified) at the small village of Conel, and we remained there until December 18, 1946, when I flew back to Davao City. Castro collected in the area until December 22, 1946, and between January 7 and January 30, 1947. During this second visit he spent some time with the Bila-an tribes at a number of places, all within one or one and a half days' walk from Dadiangas. The Bila-an place names appearing on his labels we cannot spot on the map, and he cannot indicate their location with any degree of accuracy. The place names are Akbul, Balcayo, Beto, Bugad, Bula, Calungkingad, Mallu, Neto, Olimpog, Sadsapan, Sputon, and Tanog.

We were interested in the grasslands chiefly because of the characteristic birds and the large straw-colored deer that abound in it. The deer contrast sharply with the very dark forms of the Mount Apo forests. The grasslands are well drained and almost uniform, and insects and most other animals are scarce in them.

Moderate lumber cuttings in the forest at Conel have opened it to a great variety of growth, and invertebrate and herpetological collecting was especially good there. Cart wheels have been cut out of the great buttresses of old trees in the forest and the resulting round "windows" are from three to five feet in diameter. Numerous logs on the ground provided good hunting for certain insects and arachnids. Frogs were numerous in the streams and in the vegetation of the forest, lizards and snakes were abundant, and flying lemurs were especially common in tall hollow trees. On a shrub over a little forest pond, I found the frothy egg mass of a banana frog (*Polypedates*). The tadpoles fall into the water after hatching. We took some specimens in a near-by *barrio*, where second-growth forest and grassland met.

OPERATIONS IN PALAWAN PROVINCE

The various groups of islands that fall within the political boundaries of Palawan Province (see fig. 6) are of intense interest because of their close biological affinities with Borneo and their great dissimilarity from the rest of the Philippines. In addition, they are the least explored and the least inhabited islands of the entire archipelago, with the exception of the Cuyo and Calamianes groups.

The terrain and climate of Palawan Island do not encourage settlement and exploitation, and the resistance of the pagan tribes quickly discourages encroachment in the mountains, which remain virtually unknown to this day.

The southernmost islands, the Balabac group, of which Balabac and Bugsuk are the largest, are seldom visited by boats and the fauna is known only from a few specimens. Lying as it does between Borneo and Palawan, this group deserves an intensive survey, which should be quite easy for anyone who can get his supplies transported and can arrange a sure way to return.

To the east of Palawan Island, in the southern Sulu Sea, Cagayan, Sulu and several other tiny islands have a distinctive, impoverished Palawan fauna known from only a handful of specimens. These islands are even more isolated than the Balabac group, and we were unable to visit them. Also to the east, about halfway between central Palawan and Panay, is the Cuyo group, with a Palawan fauna and some Panay elements also. This group, which is thickly populated, is visited weekly by boats. No forest remains on the island. Separated from northeastern Palawan by a small channel is Dumaran Island, of some size, also worthy of considerably more investigation, as are many of the tiny islands along the east coast of Palawan. To the north, the Calamianes group, composed of a great number of islands, carries the Palawan fauna to its northern limits and is isolated enough for some speciation. Possibly a very small fraction of the fauna has extended itself north to near-by Mindoro Island, which, however, has the character of the Philippines proper. The two important islands of the Calamianes group are

Busuanga, noted for its high quality manganese deposits, and Culion, noted for its leper colony. Both these islands have a moderately large population, are visited by one or more boats each week,

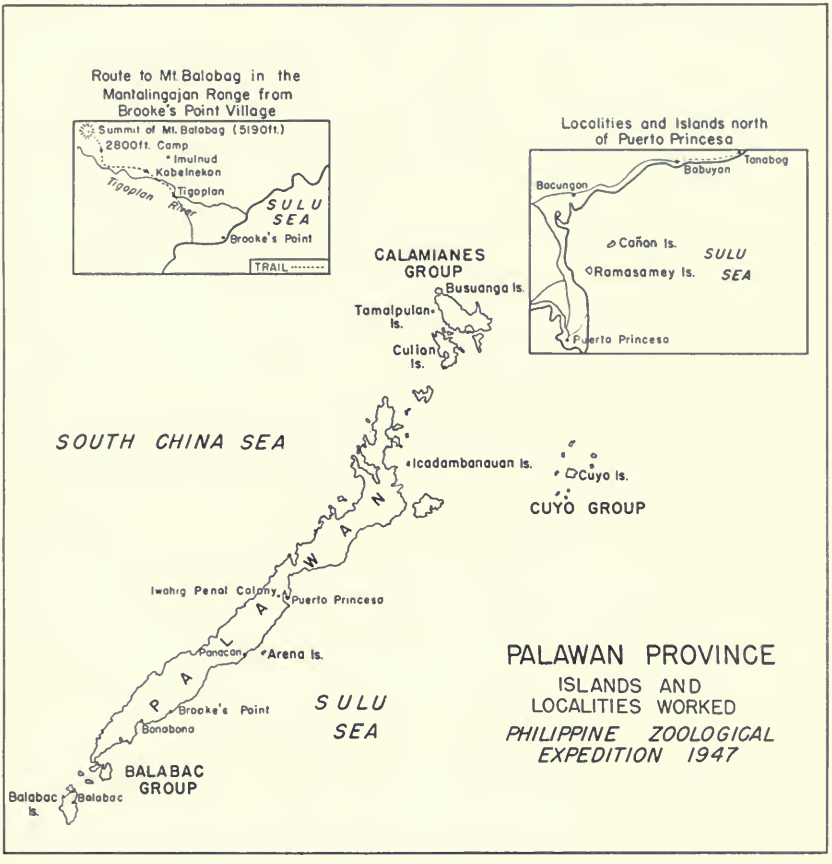

FIG. 6. Palawan Province, showing islands and localities reached by the expedition.

and are almost totally cleared of all forest except for scrubby second growth.

Whatever islands lie in the unexplored waters west of Palawan Island are unknown except by hearsay. It is possible that some islands may have a bit of vegetation and a few bats or rodents.

In the center of these groups, magnificent Palawan Island, a formidable mountain range with little or no coastal plain, extends between 8° and 12° N. Lat. The island has been little explored,

and undoubtedly still has a large number of undescribed animals. There are some passes through the mountains and it is possible to walk from the end of the road north from Puerto Princesa to the west side of the island in one day. A man with lumber interests on the other coast frequently made the trip. We regretted that because our time and money were running low we could not visit the caves, navigable streams, and precipitous cliffs on the west coast.

According to the published information concerning the islands of Palawan Province, all of them have two pronounced seasons, dry in winter and spring, wet in summer and autumn. The central-eastern slopes and lowlands of Palawan Island are of an intermediate type, with no very pronounced rainy period and with a short dry season lasting only from one to three months. At Puerto Princesa and Brooke's Point the rains were only light and infrequent. In the mountains of the Mantalingajan Range, the rains were heavy. The Calamianes were parched during our stay, as were Cuyo and Balabac. The listed annual average rainfall for Puerto Princesa, the only weather station reported for the province, is 2,216 millimeters, which appears to be about a mean for listed Philippine stations.

Our mountain party did not take temperature readings, but in the Calamianes and at Puerto Princesa, the temperature at night usually fell to 72° F., sometimes to 70° F. During the day the temperature reached from 83° to 94° F., with an average of 88° F., in shaded, breezy spots. The humidity was always high.

Palawan Island and Adjacent Islands

PUERTO PRINCESA MUNICIPALITY

Puerto Princesa (Town) Area

The permanent Palawan Province Base Camp, established on March 8, 1947, and maintained until May 25, was located in the headquarters area of the United States Army Air Base on an area of the coast sometimes referred to locally as Canigaran, a few kilometers out of the town of Puerto Princesa (see fig. 7). Outside of the Puerto Princesa town area, our operations in this municipality were at Iwahig Penal Colony and its immediate environs, and in the Babuyan-Bacungan area. Near-by Cañon and Ramasamey Islands were also visited. These localities are reported in the following sections.

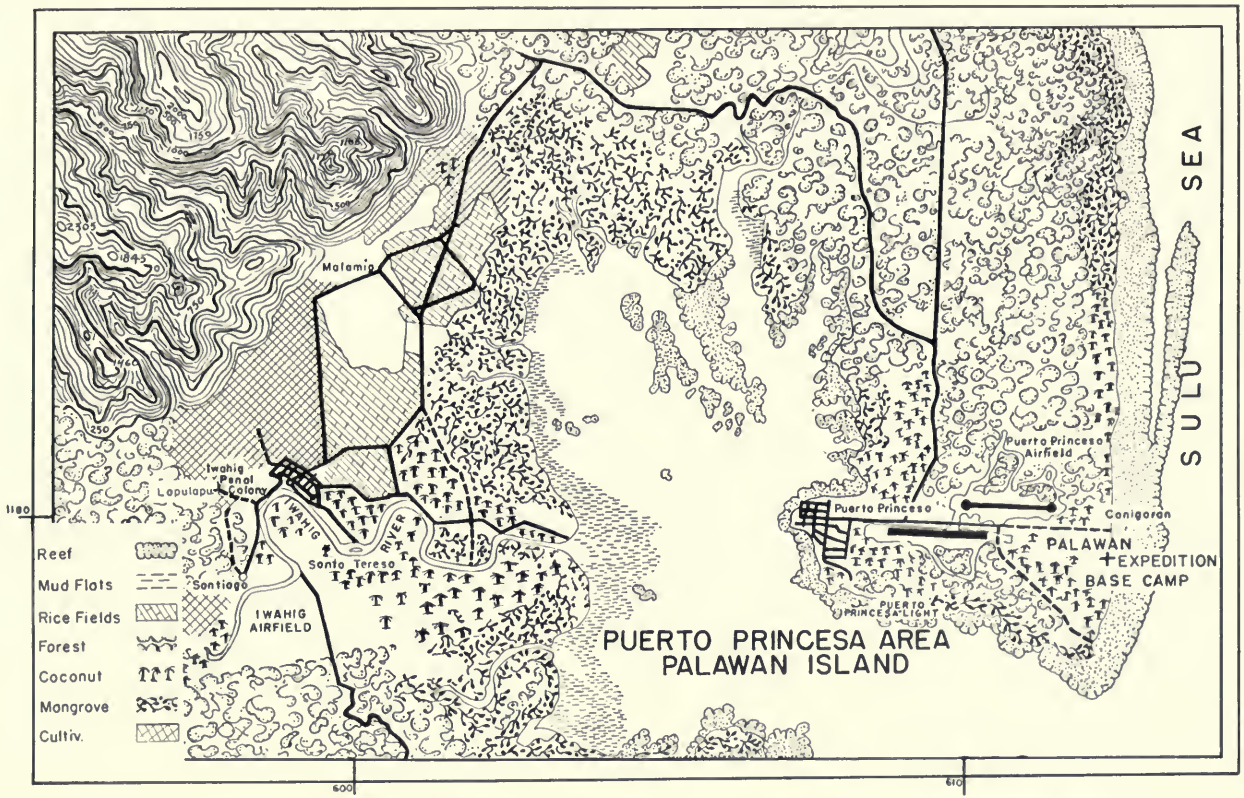

FIG. 7. Diagram showing distribution of vegetation in the Puerto Princesa area, Palawan Island.

At present Puerto Princesa, the provincial capital, is served once a week by the Philippine Air Lines and once a week by boats of the General Steamship Company of Manila. The town of Puerto Princesa has a population of about a thousand Christian Filipinos, many of them well educated and hospitable. It is the only town on the island with more than a handful of Christian Filipinos, and serves chiefly as a shipping center and provincial capital. The proximity of the large penal colony at Iwahig increases the town's importance. Copra is the only local product. Sail boats and a few small power boats bring in produce from other parts of the island for shipment to Manila and distribute the goods from Manila, but sail boats are not dependable because of storms or long calms, and the use of power boats is restricted because of the high cost of fuel. The harbor is well protected, but the entrance to it is tricky and should be attempted only by navigators acquainted with the reef that extends from one to two miles offshore along the east coast. A reasonably good road extends from the town of Puerto Princesa east to Canigaran, north to Babuyan, and west to the Iwahig Penal Colony. A very rough road, with two bad forks, extends south to Aborlan, and travel over it is precarious.

The Puerto Princesa area has been occupied since early Spanish days and little original forest remains in the vicinity. Coconut plantations and small agricultural plantings are scattered everywhere and the intervening areas are overgrown with grass and many types of second-growth forest from five to a hundred years old. This is the only extensive lowland area on the east coast of Palawan. It is ringed by high mountains, most outstanding of which is Cleopatra's Needle, just to the north.

We had hoped to establish a camp in the near-by mountains or at least in the foothills, so that we might study the original forest flora and fauna, but we were unable to procure carriers and guides and our money was running out. As it was, the richness of the second-growth area provided a constant stream of specimens representing a large proportion of the known vertebrate fauna of the island, so that our time was profitably spent. Inasmuch as only a few dozen rodent specimens had previously been reported from the island, we gathered large series, and the resultant collections well justified the effort.

As stated in the introduction to the section on the Palawan Province, we worked this area during the dry season, and consequently the forests and grasslands were all very dry. The small

streams were dry also. Rains fell on fewer than a dozen days during our stay, though overcast days were more frequent. Humidity was always high, and the temperature in the shade varied from a low of 70° F. at night to well over 90° during the daytime.

All collections labeled "Puerto Princesa" are from five miles off the coast east of town. A fringe of coconut groves borders the entire length of this coast. Behind this, except in the airport area, is an old second-growth forest with such thick undergrowth that penetration is usually difficult. Large coral rocks are scattered over most of the area, and the ground is covered with a heavy leafy humus. The populations of some species of vertebrates and invertebrates were surprisingly large, as will be indicated in the field notes on the various groups. Frogs and toads, snakes, and all but a few species of lizards, however, were as scarce as at any locality we visited in the Philippines, and considerably more so than at the Iwahig Penal Colony. Within this area of forest there is some degree of isolation and variation in spite of its rather similar facies throughout (except of course at the edges, which differ considerably because of different types of disturbance and adjacent growth). Large populations of *Rattus palawanensis* and *Tupaia* could be found in some parts of the forest, while in other parts, apparently quite similar, we found no specimens.

In the vicinity of the airport all the forest has been cleared and tall grass has taken its place. Some of this clearing was done before the war and a recent growth of trees has established itself. There are no streams here; in only a few places there are small, wet depressions. Mangroves are scattered up and down the coast, but nowhere in solid stands, and there is no spot more than a hundred feet above sea level. There are a few small agricultural plantings in the area, and a number of abandoned fruit trees, especially banana and papaya, which are visited by birds and mammals.

The only land mammals heretofore listed from Palawan Island (except for some localized listed races of squirrels) that we did not obtain at this locality were the shrews (*Suncus*) and the bear cat (*Arctictis*).

Babuyan-Bacungan Area[1]

A party composed of Werner, Castro, Oañe, and Edaño spent about a week (March 14 to 22, 1947) in this area in the hope of securing guides to conduct them into the mountains. Babuyan is

[1] From notes of F. G. Werner.

the northernmost extension of the road from Puerto Princesa and is on the main route north. Directly behind the village is the picturesque mountain, Cleopatra's Needle, and north of it a plateau that is one of the most extensive highland areas of Palawan. Inasmuch as guides and carriers were unobtainable, camp was set up on a small side arm of the Babuyan River, which is as far as one can go by truck, and local collections were made. The entire area is covered with rather scrubby second growth, apparently the result of war-time neglect of agricultural land. There are several patches of trees thirty feet high, and mangrove areas border the river. The vegetation near camp consisted of low shrubs and scattered trees, and small clearings in this growth were being made near-by. As in most second-growth areas the ground cover was thin and the soil extremely dry. Insect collecting at this station yielded negligible results during the extremely hot parts of the day, and a line of rat traps was quite unsuccessful. The only small shrew (*Crocidura* sp.) taken on Palawan was obtained here when Werner found it stumbling across the path one morning. Of great interest because it is unrecorded from the Palawan group is a naked bat (*Cheiromeles*), which Werner shot early one evening as it flew low over the trees. Tagbanuas from the *barrio* of Babuyan brought in specimens, and some birds were shot from a boat on the river.

On March 20 the party went by boat to Mauyon, a *barrio* about a mile upstream, where Werner did some collecting in the forest.

Cañon and Ramasamey Islands[1]

These islets are just outside the reef that extends a mile or more from shore, slightly north of Puerto Princesa Bay. We had had reports of bat roosts on Cañon Island, and so, on April 16, Werner and Oañe set out for a one-day trip in a tiny sail boat. Currents and winds delayed the arrival until dark, when the bats were leaving to feed, but in the morning the party located a colony of *Pteropus* bats in the mangrove swamp and obtained a sample of these as well as several nutmeg imperial pigeons. Several phalaropes were taken on coconut-planted Ramasamey Island on the coral sand beach.

IWAHIG PENAL COLONY[2]

Base camp was established in the Colony headquarters, on February 28, 1947, and several days later a field station was set

[1] From notes of Floyd G. Werner.

[2] From notes of Harry Hoogstraal and F. G. Werner.

up at Lapulapu, on the Lapulapu River and at the border of an extensive second-growth forest. This was our first camp in Palawan Province, and Hoogstraal, Añonuevo, and Oañe had not yet arrived. The relatively great distance from suitable collecting places, the lack of transportation within the Colony, and the unavailability of carriers for a trip into the forested mountains reduced the value of our time here, and on March 8 we moved to the Palawan Army Air Base near the town of Puerto Princesa and set up our permanent camp. Later Castro stayed at the Penal Colony from time to time to care for specimens.

A number of names of places in and immediately contiguous to the boundaries of the Colony appear on the labels, and these are listed in the Palawan Section of the Expedition Itinerary. We are not sufficiently well acquainted with the area to discuss these places specifically.

A large variety of situations exists within this area. Most of the land is devoid of trees and is devoted to corn and rice. The rice paddies are irrigated, and many are fallow and overgrown with sparse grass. Other large sections are devoted to grazing. Fruit and shade trees are common near the many small groups of human habitations, and there are a few coconut groves. There are also some forests, especially in the hills and low mountains to the west, though most of these, especially those closer to the center of the Colony, have been more or less disturbed. Canals run throughout the Colony and in some places a dense growth of grass and weeds borders the Iwahig River. Many of the small streams ebb and flow with the tides. Mangrove borders most of the coast of Puerto Princesa Bay. Except for the western part, almost all of the area is exceedingly flat. The Colony has been in operation for some forty years, and we were told that it is now considerably less fertile than it was heretofore. A good gravel road connects it with the town of Puerto Princesa.

On March 2 Werner traveled up a dry stream bed to the *Agathis* forest at between 3,000 and 3,500 feet on an unnamed mountain west of Lapulapu, Iwahig, and south of Thumb Peak. He stayed overnight at the camp of some copal gatherers and was given a Palawan peacock pheasant that they had snared. Insect collecting on this trip was poor because of the drought.

Much of the knowledge of Palawan vertebrates is based on specimens collected at the Colony. We were chiefly interested in mammals from this area and we secured a good proportion of those known from the island, many in excellent series.

BROOKE'S POINT MUNICIPALITY[1]

On this trip the expedition made what appears to be the only zoological collection ever to come out of the mountains of southern Palawan. The Palawan trip was at the end of our itinerary, when our resources were stretched to the limit, and the isolation of the Brooke's Point area and the extreme cost of reaching it with any worthwhile amount of equipment made this a shorter trip than we had wished to make. The mountains of Palawan justify an intensive and extensive campaign of investigation by zoologists. The isolation of the region and the hostility of the native tribes have previously deterred exploration.

The party, composed of Werner, Rabor, Celestino, Edaño, and Oañe, left Puerto Princesa in a launch and reached the tiny village of Brooke's Point on the afternoon of April 23. There camp was set up in an abandoned tin-roofed building, and Werner immediately made plans to get to Mount Mantalingajan, the highest mountain in Palawan.

While waiting for carriers, Werner made a survey of the area for good collecting spots. Just south of the inlet was the spot where Taylor collected the type specimens of *Rattus palawanensis*. This is now a region of second growth. Most of the Brooke's Point coastal area has been planted with coconuts, but a heavy second-growth scrub is growing beneath the coconuts, and this scrub supports a great variety of animal life. A mangrove swamp borders the inlet about a mile south of the settlement and almost all the rest is grassland and dry, scrubby second growth, with occasional bamboo patches.

On April 26 the cargo boat arrived, was loaded, and left. On the following day, the group proceeded, with a carabao and cart, toward the base of the mountain. Starting in the afternoon, to spare the carabao the noonday heat, the party reached Imulnud *barrio* the first night. Here they collected a few rats in the buildings. On April 28 they reached Tigoplan, as far as a carabao can go, on the trail to Mantalingajan.

Tigoplan *barrio* is on the Tigoplan River in second-growth forest. The party stayed there for four days and during this time they picked up a few rodents and reptiles as well as plants and insects.

On May 2 Werner rounded up carriers and got the co-operation of the assistant head man of the first and largest Palawan *barrio*,

[1] From notes of Floyd G. Werner.

Kabelnekan (1,400 feet elevation). The party reached this *barrio* in a couple of hours, proceeding up the Tigoplan River and then up a steep hill. The *barrio* spreads over much of the east side of the hill and consists of scattered bamboo houses with cleared land around them. Upland or dry rice is planted on slopes up to forty-five degrees. The people are generally quite prosperous. They raise rice, sweet potatoes, cassava, gabé (an aroid, of which the rootstalk is eaten) and sugar cane, and trade copal and rattan for their few other wants.

That evening, the head man, Panglima ("headman") Osungan, returned and he secured guides for the trip, even calling others in from neighboring *barrios*, since the number needed could not be supplied at Kabelnekan. Here Werner and his party learned first-hand why they could not go on without proper preparation. The Palawans use a set-spear to kill wild pigs and deter human visitors. These spears are made of a heavy palm shaft with an exceedingly sharp bamboo head and they are rigged to hit about shoulder high on a pig when the trigger, a piece of stick or vine, is touched. No further explanation was necessary, and Osungan was allowed to make the arrangements from there on.

The first day the guides led the group over the ridge behind Kabelnekan at about 3,000 feet, then into lush virgin forest in the Tigoplan River Valley. The following day they worked up the rocky and rapid river, crossing it many times and clambering over rocks along the exceedingly slippery, steep trails. By late afternoon they had reached the highest *barrio* on the trail, Katagatan (elevation about 1,300 feet), on the south side of Mount Balabag. Katagatan is very primitive, with a few bamboo huts and a small clearing, and is not nearly so prosperous as Kabelnekan. On the following morning the party got up to 3,200 feet, and the tarpaulins and jungle hammocks were set up on the bank of a small stream, apparently the only water supply on this side of the mountain. Werner was under the impression that he was on Mount Mantalingajan and was much surprised to see this noble mountain to the west on a day when the sky cleared. He was on Mount Balabag, in the Mantalingajan Range east of Mount Mantalingajan and separated from it by a great valley from which issue the headwaters of the Tigoplan River. Mount Mantalingajan itself is called Iloilo ("poison") by the Palawans and apparently is never visited by them.

Mount Balabag turned out to be well worth the trip. The camp at 3,200 feet was in virgin forest, in the zone where copal is collected

from a species of *Agathis*, a huge tree with white bark. This tree is scattered through the forest and is the largest species there. The ground everywhere was saturated, for the rainy season was just beginning, and rain fell almost every day. Frogs of several species made a great clamor at night and insects were abundant and varied. Up the knife-like, steep slope of Balabag the flora changed to the stunted, moss-covered, heath-like growth of the cloud forest. Werner trapped for small mammals at about 4,000 feet in the mossy forest but succeeded in obtaining only *Rattus palawanensis* and one other *Bullimus*-type rat. The insect and frog fauna of this high area was as different as the flora, and collecting was good to the summit, at about 5,000 feet. Two peculiar frogs were taken only near the summit, on the moss on the ground. Besides the insects, amphibians and mammals that were taken, the Palawans brought in flying squirrels and a distinctive spiny rat. Squirrels and *Tupaia* were fairly numerous and *R. palawanensis* was abundant everywhere. The hoped-for prize of the trip, a very large rat with a white tail, reported many times by the Palawans, was not taken, nor was the bear cat, *Arctictis*, called "manturong" by the Palawans. This animal was seen once but snares set for it by the Palawans were not successful.

The party was able to spend only ten full days on Mount Balabag, for the long delays at the start had stolen too much time. By taking the lead in the column, Werner was able to conduct the whole party back to Brooke's Point in one day, from 7:00 A.M. till 10:00 P.M., a distance which had taken almost two weeks to negotiate on the way up.

ABORLAN MUNICIPALITY[1]

Arena Island (see fig. 6) lies offshore less than a mile and is hardly more than a small, ten-foot-high hill of sand overgrown by scrubby second-growth brush and trees. The launch on which the Brooke's Point party was traveling anchored off here at nightfall while en route from Puerto Princesa and, to pass the time, Werner set a line of traps from the *Pandanus* zone along the shore into the forest. It was with considerable surprise that he found a good series of a large *Rattus*, poorly or not at all represented in our other collections, in the traps the next morning. Several nutmeg imperial pigeons were seen on the island, and there were several opened nests of the mound-builder birds (*Megapodius* sp.).

[1] From notes of F. G. Werner.

ICADAMBANAUAN ISLAND (OFF NORTHEAST PALAWAN)

While our launch lay offshore of Icadambanauan en route from the Calamianes to Puerto Princesa on April 5, 1947, we collected some invertebrates on and near this island. Most interesting of these were hemipterous marine water striders, which we scooped up in a little cove at night when they came to a light hung overboard.

Calamianes Island Group

The Calamianes group consists of a number of islands, chief among them Culion and Busuanga, just north of Palawan and south of Mindoro. These islands, politically a part of Palawan Province, comprise Coron Municipality. Geologically and faunistically they are a part of the Palawan group, and they carry the characteristic Bornean elements (of the Palawan types)[1] to their northern limits in the Philippines. A number of Palawan animals have speciated on these islands, while many others appear to be identical with the Palawan fauna.

It is of considerable interest to note the presence of deer (*Rusa*) on the islands of the Calamianes group, since they are absent on Palawan Island. This fact has been used by some authors to show that the Calamianes are older geologically than Palawan. It appears to me that the strong possibility of the intentional planting of deer by early inhabitants should be considered. Historically and to the present day, small islands (such as those of the Calamianes) in the Philippine archipelago have been earlier and more thickly settled than most of the more rugged larger islands. Constant burning and clearing in conjunction with human settlement have allowed extensive growth of grass on these islands, and this grass can and does support surprisingly large herds of deer in the Calamianes, as it does on other islands, in spite of a rather large hunting population. Old church records attest to the frequent attempts of Filipinos to transplant deer from one island to another. The presence of a carabao, described by von Mollendorf as a separate species on Busuanga (absent on Palawan) is in all respects too questionable to be used as a faunal indicator. The presence of Taylor's tree rat genus, *Insulaemus*, on Busuanga and not on Palawan has also been used by him as an argument to show the great antiquity of the

[1] That part of the Bornean fauna which has extended to other parts of the Philippines, assumedly via the Sulu archipelago and Mindanao, is considerably different, probably because of age, from that which has invaded Palawan and the Calamianes via the Balabac group.

Calamianes; Werner and Hoogstraal, however, took a dozen specimens of this genus on Palawan. There is considerable research to be done before the Philippine mammal fauna can be analyzed as to zoogeography, except possibly in broadest outline. Some of the animals not now found on the Calamianes but present on Palawan may easily have been exterminated from the former by the intensive and complete removal of the original forest from the Calamianes long ago. The greater distance of the Calamianes from the dispersal area of Borneo is also to be considered in comparing the fauna of the Calamianes and Palawan.

The most succinct commentary on the conservation of what little forest remains in the Calamianes might be the statement that during our stay of several weeks there we were never out of sight of at least one and usually several tall columns of smoke from fires set to clear the land for grazing.

BUSUANGA ISLAND[1]

A few days after the party had assembled at Puerto Princesa for the operations in Palawan Province, Hoogstraal, Rabor, Celestino and Añonuevo departed for Coron, Busuanga, via Cuyo. They arrived at the town of Coron (not to be confused with near-by Coron Island) on May 11, 1947.

The season at Busuanga was extremely dry, though numerous small streams continued to flow out of the hills. All of the island that we saw was grassland, with narrow areas of trees and dense thickets along some of the streams and more or less scattered trees here and there in the grasslands. A conspicuous tree everywhere is the cashew, the fruit of which is a delicacy much sought by human residents and visitors as well as by many of the local mammals and birds. We learned, just before leaving Busuanga, that a small area of original forest remains at Minuit, on the north coast of the island, where Taylor obtained the type specimens of *Insulaemus*, but we were unable to reach this place in the time remaining. The low, rounded hills are much eroded and the grass on them, as well as in many places in the lowlands, is often sparse and is continually burned. We find it difficult to believe that these sparse grasslands support the heavy deer population that they do, even though hunting is unrestricted on the island. In spite of the extreme general dryness, we observed and collected in a number of small depressions containing

[1] From notes of Harry Hoogstraal and Dioscoro Rabor.

pools of seepage water. On near-by Culion Island, which we visited later, such pools were found only in the stream-beds. Rice was once extensively grown in the lowlands but has been almost entirely abandoned because of poor yield. Grazing is localized on the island.

Busuanga Island has considerable deposits of high grade manganese, and much of the land has been staked out with mining claims. These deposits were first discovered by Professor J. Otley Beyer of the University of the Philippines, who noted a considerable amount of this rather rare metal among specimens of tektites or rizalites, strange obsidian stones thought to have their origin outside of this world, which were being sent to him for study during the early 1900's.

The Luzon Stevedoring Company's chief operations are in the Singay area, several kilometers from Coron, and these we visited later. The entrances of abandoned mines were good hunting places for swifts, small fruit bats, and porcupines. Small areas of much disturbed remnants of original forest and dense second-growth forest, even those being ruthlessly cleared, remained in the Singay area, and among these we obtained four specimens of an interesting pale fruit bat (a new species of *Pteropus*).

On March 14 our party encamped at the small *barrio* of Dimaniang, where the Sandoval family extended us their hospitality. During our stay at Dimaniang we visited and collected in the near-by *barrios* of Carmelita, Pangawaran, Tulawa, San Nicolas, Bintuan, and Sinamay, obtaining interesting series of specimens. A variety of frogs was abundant in the pools and in the streams, and large crocodiles, some of them reputed to be man-eaters, were common in the rivers. Bird life was abundant but restricted to grassland and open forest species. Among the mammals, we entirely missed the remarkable tree rat *Insulaemus*, known only from the type specimen taken on Busuanga, though we later secured a good series on Palawan. The *Rattus luteiventris* group was present, but not in large numbers, and several specimens of the *Rattus palawanensis* group were taken, apparently for the first time in the Calamianes, along the water-courses. As stated earlier, deer were numerous, as were wild pigs and monkeys, the badger skunk (*Mydaus*), the porcupine (*Thecurus*), the Malay civet (*Viverra*), and the palm civet (*Paradoxurus*). Squirrels (*Sciurus*) were very common in some thickets, but tree shrews (*Tupaia*) were not common. The scaly anteater (*Paramanis culionensis*) is apparently localized on the island.

We were particularly interested in noting the high incidence of fleas and mites, lice and ticks here as compared with the other low-

land averages throughout the Philippines and New Guinea, and we attribute this phenomenon, in part at least, to the dryness of the season. Possibly of equal interest among the insects was the variety and quantity of aquatic forms concentrated in the small pools and streams.

CULION ISLAND[1]

On March 24, 1947, we secured passage on a small launch bound for Culion, an island similar in most respects to Busuanga. The population is limited to lepers and those connected with the leper colony. Second-growth forest, rather than open grassland, is more extensive on Culion than on Busuanga, and great areas of forest were being burned during our stay. Before the American government took over the island for a leper colony in the first decade of the 1900's, much of the flat land was devoted to rice paddies. These areas have now grown into sparse grassland with widely spaced trees, and present a parklike aspect. The Filipinos call them *parang*-land.

San Pedro, about ten kilometers west from the Colony headquarters, lies on one of the mangrove inlets that are so frequent on Culion. A dense scrub forest, with many vines and shrubs, borders the tidal rivers. A very small degree of moisture remained in the humus lying in some of these stream-beds, and a considerable amount of interesting insect life was concentrated in these spots. The only phalangids found on Culion were taken in deep, horizontal holes in the shaded side walls of one river-bed. The Java frogmouth (*Batrachostomus javensis chaseni*), one of the rare birds taken on the expedition, was shot in the dense thickets beside one of these stream-beds, and in another one a number of bats were taken in bat nets strung over a mucky pool. The mucky pools provided a great variety of frogs and toads and some snakes. The Malay civet was common here, though we found none on Palawan Island and were not able to secure reliable reports of it there. The badger skunk (*Mydaus*), which is common on Busuanga and Palawan, is apparently absent on Culion. And we should not forget to mention the king cobra (*Naja hannah*), which Celestino found looking him squarely in the face early one morning as he walked up a dry river-bed. In the grasslands at San Pedro, insect specimens were generally rare, except on some trees and shrubs, such as the flowering *duhat* tree (*Eugenia* sp.) and *Pandanus*. While at San Pedro, collections

[1] From notes of Harry Hoogstraal and Dioscoro Rabor.

were also made from the near-by *barrios* of Mahupa, Makinis and Aborabod.

Most of the small lot of insects collected by Celestino at Siuk, a small hamlet across the bay from the Colony headquarters, were different from those taken at San Pedro. Siuk has the same combination of flat grasslands and low scrubby forest hills that we found at San Pedro, but there is no grazing there and the grass was as high as a man. The forest was densely grown with rattan and light bamboo. While the party was at Siuk, clearings were being made in the grass and forest, and deer hunting was good in these places.

TAMALPULAN ISLAND

Only one vertebrate specimen, a megapode, and a few invertebrates were secured from Tamalpulan Island, which we touched briefly, en route from Culion to Puerto Princesa, on April 4, 1947.

Balabac Island Group

On May 15, 1947, we spent fourteen hours on Balabac Island. The party was composed of Hoogstraal, Rabor and Añonuevo. We had hoped to remain for several days, to collect forms related to those of Palawan and Borneo, as well as those occurring on all three islands, but the boat on which we travelled would not wait. This, the most far-flung island group in the Philippines, is actually in closer commercial contact with British North Borneo than with the Philippines. It is visited but two or three times a year by ships, although sail boats call more frequently.

Balabac Island is known to mammalogists because it is the only one in the Philippine group on which the pretty little mouse deer (*Tragulus*) occurs, though it has been established on near-by Bugsuk Island. Attempts to transplant it to Palawan proper have failed.

We were able to collect only in a stream, a dry second-growth forest with a few damp depressions in its floor, and an overgrown coconut plantation. Añonuevo shot two mouse deer in less than an hour, we purchased two others, and one was presented to us by Lieutenant DeVera, commanding the military police station. These animals are abundant on the island, and are eaten by the poorer people or by all the population when other food is scarce.

Insect collecting was excellent in all types of growth in spite of the dryness, and several kinds of frogs and toads were abundant in

the stream. Rodents were reported numerous in the houses, but between nightfall and 10:00 P.M. my line of fifty traps in buildings caught nothing. Two rats were taken in my outdoor traps, one, the large form of *Rattus luteiventris*, in a dense thicket, and the other, the small form of this species, in a rocky, grassy area. We had been particularly anxious to obtain squirrels and tree shrews here, but missed the two squirrels we saw. A good collection from Balabac would have greatly enhanced the value of our Palawan series, for the island has been but little collected and is an important faunal stepping stone between Borneo and Palawan.

Cuyo Island Group

Cuyo Island is the most important of this group of numerous small, low islands lying in the center of the Sulu Sea between central Palawan and Panay. It is of considerable interest because it is an outlier of Palawan Province and has an impoverished representation of that fauna, much of which has speciated here by reason of isolation. Most of the forests are completely cut over. The monitor lizards (*Varanus*), which measure from three to six feet and are extremely abundant, are a conspicuous element of the fauna.

I visited the island en route to the Calamianes for only a few hours while my boat lay offshore, but Castro and Añonuevo collected here from May 24 to May 30, 1947. These were the last vertebrate collections made by the expedition.

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Fig. 1. Drawing of façade of Philippine Bureau of Science building, before World War II

Fig. 2. Ruins of Bureau of Science building, 1946

THE PHILIPPINE BUREAU OF SCIENCE

Fig. 1. *Dipterocarpus* logs

Fig. 2. Manila hemp drying near Davao

INDUSTRIAL DEVELOPMENT IN THE DAVAO REGION
MINDANAO ISLAND

Fig. 1. A tarsier in the second-growth coastal scrub at Caburan, Davao

Fig. 2. Clearing second-growth timber for a Manila hemp plantation

SECOND-GROWTH TIMBER, MINDANAO ISLAND

Fig. 1. Mount Apo Range from the northeast. The main peaks, from left to right, are Mount Apo, Mount McKinley, and Mount Washington

Fig. 2. Insect-sorting bench at Mount McKinley base camp

MOUNT APO RANGE AND MOUNT McKINLEY BASE CAMP

Fig. 1. Mossy stunted forest (elev. 7,200 feet)

Fig. 2. Mossy forest (elev. 6,400 feet)

MOSSY FOREST ON EAST SLOPE OF MOUNT McKINLEY

Fig. 1. Ground palm and arboreal fern at Mainit camp (elev. 4,300 feet)

Fig. 2. Boulder field below crater (elev. 9,600 feet)

MOUNT APO

Fig. 1. View from crater border of Mount Apo. The light area in the center is grass, that to the left of the lake is a bog

Fig. 2. Vegetation at border of lake

LAKE LINAU

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